SCIENTIFIC AMERICAN SUPPLEMENT No. 150

Scientific American Supplement, Vol. VI., No. 150.
Scientific American, established 1845.

NEW YORK, NOVEMBER 16, 1878.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

AMERICAN GEOLOGICAL SURVEYS.*

GEOLOGICAL AND GEOGRAPHICAL ATLAS OF COLORADO AND PORTIONS OF ADJACENT TERRITORY. By F. V. HAYDEN, U. S., Geologist in Charge. (Washington: Published by the Department of the Interior, 1877.)

IN the magnificent Atlas just issued by the Department of the Interior we have the consummation and crown of all the labors which Dr. Hayden and his staff have carried on so triumphantly for the last five years, and of which they have already given us so much interesting and important information in a series of Annual Reports. Before examining the work from a scientific point of view, no reader can refrain from expressing his admiration of the style in which the Atlas has been produced by the United States Government. As a specimen of cartography, typography and lithography, it is altogether worthy of the highest praise. For beauty and indeed sumptuousness of execution, it may be classed with those *livres de luxe* which from time to time have been issued from the National Imprimerie of France.

The Atlas consists of two series of maps, the one of a general, the other of a detailed kind. The first series, on the scale of twelve miles to one inch, comprises four sheets, each embracing the whole State of Colorado and part of the neighboring Territory. The first of these illustrates the system of triangulation adopted in the survey; the second shows the drainage system of the area; the third by a simple and clear arrangement of colors, exhibits at a glance the economic features of the whole region—the agricultural land, pasturage, forests, and woodlands, sage and bad lands, mineral tracts, and the portions rising above the limit of timber-growth; the fourth contains a condensed and generalized geological map of the same Territory. Nothing can surpass the lucidity of expression and artistic finish of these maps.

The second series—twelve in number—is on the scale of four miles to one inch, and consists of six topographical sheets and six identical sheets, colored geologically. The topographical details, though numerous, are so selected as not to neutralize each other, or mar the broad, clear picture which the maps were designed to be. By means of contour lines of 200 feet vertical distance, the surface-configuration of the whole region is depicted as in a model. We can follow the lines of the broad valleys, of the deep, narrow cañons, and of the hundreds of minor tributaries which have scarped out their courses on either side. Here we look down upon a vast table land, deeply trenched by stream-channels; there upon a succession of bold escarpments or mesas which bound the table-land and hem in the neighboring valley. Huge mountain ranges rising out of the plateaus are so vividly drawn that they seem to stand out of the paper. Yet no shading is employed. All the effects of inequality are produced by contour lines, so faithfully set down that a single line may be tracked in its sinuous course along the whole of a mountain front until it comes out upon the table-land beyond. When will our map makers learn to use this, the only true method for expressing the surface of a country? The best of our atlases are disfigured by strips of shading running across the map like so many caterpillars, to represent mountain ranges. Even our Ordnance maps, so admirable in most respects, are sometimes so loaded with shading, that a steep hill-side only a few hundred feet high is made as black as our highest mountains, and the topographical names can hardly be read.

But, above all, welcome are these six geological maps. In the previously published maps and charts accompanying the Annual Reports, only small detached areas were represented, and even from the careful descriptions of the various geologists of the staff it was hardly possible to frame a satisfactory conception of the geology of Colorado as a whole. Ever since the marvels of its deep gorges and vividly painted cliffs were made known, that region has possessed a high interest to the geologist. He has now the means of gratifying his desire for further knowledge. With the help of these maps and the two accompanying sheets of sections he can realize most satisfactorily every great feature of Colorado geology. The ancient Archæan ridge—the nucleus or backbone of the American continent—may be traced running north and south nearly along the present hydrographical axis of the country. Flanking that ridge comes a series of palæozoic deposits, the oldest of which have been identified palæontologically with Silurian formations. Rocks, regarded as of Devonian age, overlap the Silurian beds, and repose against the ancient crystalline ridge on the southwest side of the San Juan Mountains. They are soon buried under later accumulations, and they seem to be of but local development, since in most places where the rocks are found in juxtaposition, the Silurian are directly succeeded by Carboniferous strata. These last-named rocks cover large tracts of country, running as bands round the Archæan area, and lying in basins across it. Far to the west where the Grand River has so deeply trenched the Utah plateau, the flat Carboniferous beds appear from under the brilliant red Triassic strata. The difficulty of drawing any line between Triassic and Jurassic formations in that region is again acknowledged on these maps, the lower red series being doubtfully assigned to the older, and the upper variegated deposits to the later system. Cretaceous rocks are abundantly developed, and cover a vast extent of territory. In particular they spread over the wide plateaus between the San Juan and Gunnison rivers, and form the platform on which the enormous volcanic outbursts have been piled up from the West Elk Mountains southward into New Mexico. It is more easy to trace on these maps, too, the area respectively occupied by the Laramie, Wahsatch, Green River, Bridger, and Uintah formations which represent post-cretaceous and tertiary times. Glacier moraines, lake deposits, drifts, sand dunes, and recent alluvia, all find adequate expression on the maps. Especial care, too, seems to have been bestowed upon the eruptive rocks which form so important and interesting a feature of Colorado geology. The more characteristic varieties are represented by distinct shades of crimson or orange, and they have been mapped in such a way as to convey at a glance, and even without the aid of sections, a tolerably clear notion of the volcanic phenomena of the region. On the one hand we see the great lava sheets capping the mesas and spreading far over the plateaus, on the other we notice the great centers of volcanic activity, with their abundant flows, dikes, and breccias.

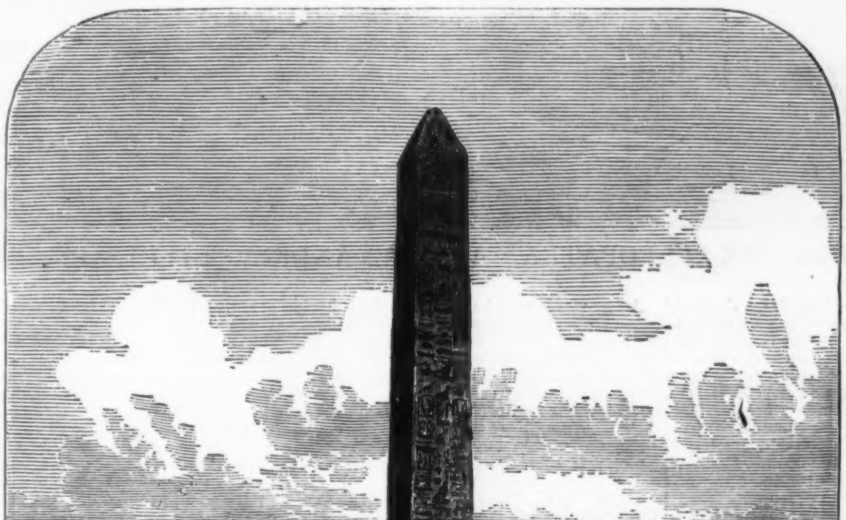
Two sheets of sections, drawn across all the more interesting and important portions of the geology, complete the vast fund of information given by the maps; while, that nothing may be wanting to enable readers to realize what has been done by the Survey, and the conditions under which it has been accomplished, two large sheets of sketches are given, which most vividly represent the forms of the mountains, plateaus, mesas, and river channels, as seen from various commanding heights.

Dr. Hayden, with whose personal supervision this great work has been accomplished, has increased tenfold the obligations under which he has laid geologists all over the world for the number and value of his contributions to geology. He now furnishes us with new light whereby to read his former researches and those of his able colleagues. May we venture to hope that he may find leisure to confer yet one further benefit before the progress of his Survey plunges him into a new whirl of work? If he could be prevailed upon to sketch out a plan for digesting the materials of his published Annual Reports, he could doubtless find among his staff some competent writer who, under his guidance, could produce a well-arranged systematic guide book or text book to complete the value of the work of his Survey. Such a book of reference as would give a reader who has never had access to the Annual Reports a clear and comprehensive view of Colorado geology, would be of very great service.

These remarks may be fitly closed with an expression of the warmest admiration of the liberal spirit in which the United States Government has conducted these Surveys of the Territories and has published their results. This costly Atlas has been distributed gratuitously all over Europe. That this is a wise policy cannot be doubted. Whether actuated or not by a desire to diffuse scientific information, the authorities at Washington do well to make as widely known as possible the geological structure and economic resources of their country. They cast their bread upon the waters, and the harvest comes to them in the form of eager, active emigrants from all parts of Europe.

ARCH. GEIKIE.

* *Nature.*



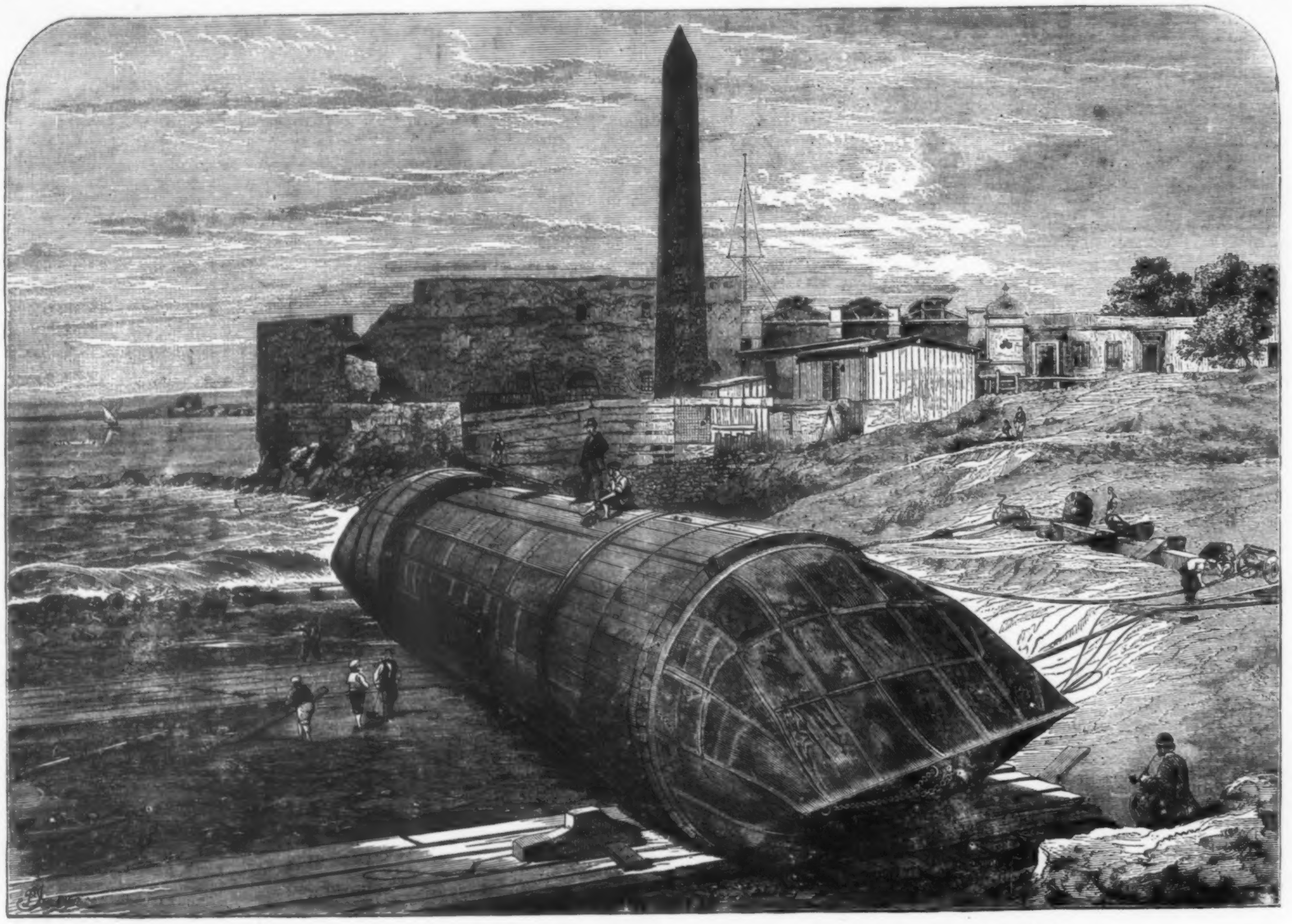
CLEOPATRA'S NEEDLE, LATELY ERECTED IN LONDON, ON THE THAMES EMBANKMENT.

CLEOPATRA'S NEEDLE.

THE engravings which we publish this week of the launch of the Cleopatra at Alexandria, Egypt, and the erection of the Needle on the Thames Embankment, London, will constitute, with the particulars heretofore given, a sufficient record of the interesting work which Mr. John Dixon has now brought to a successful conclusion. From a number of unforeseen causes and unavoidable accidents the worry and cost of transporting the obelisk have been greater than was anticipated, while the rate of progress has been less. Thus, although every detail of construction of vessel and mode of erection had been settled by Mr. Dixon and Mr. Baker early in January, 1877, and although the financial arrangement with Mr. Erasmus Wilson was also satisfactorily concluded at the same date, it was not until the middle of March that Mr. Fowler was enabled to telegraph that His Highness the Khedive "presents the Needle to the British nation through their representative, Mr. Vivian, the Consul-General."

Upon receipt of this anxiously expected telegram, for the difficulties of obtaining possession of the Needle at one time appeared insuperable, the Thames Iron Works were at once instructed to proceed with the construction of the vessel, and in due time it was forwarded to Alexandria in pieces, and built around the prostrate obelisk by Mr. Wayman Dixon, to whom the responsible duty of shifting the Needle, and preparing the vessel for the launch, had been delegated by his brother, Mr. John Dixon. With the able assistance of Captain Carter, the Cleopatra was partially rolled into the sea on August 28th, and safely docked in Alexandria harbor on September 8th, 1877. A fortnight later she was proceeding homewards towed by the Olga, and, as will be well remembered, was abandoned on October 15th in the Bay of Biscay, subsequently picked up by the Fitzmaurice, and taken into Ferrol, Spain, where she remained about three months, finally arriving in the Thames on January 20th, 1878.

There has always been a sort of latent superstition in Egypt that the removal of an obelisk entailed a certain amount of ill-luck upon the country and individuals concerned in its transport, and the present instance would appear to lend some justification to this impression, for at the launch a hidden stone pierced the skin, and so rendered the vessel and its cargo an easy prey to any gale which might have thundered the breakers of the Mediterranean against the stranded ship, while in the Bay of Biscay the Cleopatra had to be abandoned with the loss of six lives after the terrific gale of Sunday, the 14th of October, 1877. Not the least anxious part of the work pluckily undertaken by Mr. Dixon was the erection of the Needle, and it may be readily understood that after these mishaps both Mr. Dixon and Mr. Baker were thoroughly agreed to leave nothing whatever to chance or luck, but to act invariably as if the worst that could happen always would happen. This excess of caution and designed timidity of course detracted somewhat from the interest and boldness of the operations, but Mr. Dixon's stake was too great to admit of any risk, for in addition to the odium which would be incurred by failure, he would of course lose the whole of the £10,000 and upwards already expended



LAUNCHING THE "CLEOPATRA" AT ALEXANDRIA, EGYPT, SEPTEMBER, 1877.

upon the work. The mode of erection, fully decided upon even before the Needle was presented to the nation, was carefully elaborated so as to provide against every probable and improbable contingency. No chains or tackle were trusted to, for, as every newspaper reader knows, these appliances are always giving way and letting big guns drop through the bottoms of barges, and creating other surprises even in the best regulated government families. No varying strain, with consequent irregular settlement and possible lurching of the 200 ton block of granite, was admitted in the staging, but everything was arranged for a constant and equable vertical pressure.

The successive steps by which the stone was liberated from the vessel and set upon its pedestal may be summarized as follows:

1. The Cleopatra was brought alongside the Embankment with the stern nearly touching the Adelphi steps, and grounded after a high tide upon a cradle of solid blocks of timber prepared for its reception and sunk to the bed of the river by an adequate quantity of old iron rails.

2. The cabin was cut off and the circular vessel turned a quarter round, so as to bring the best face of the engraved obelisk toward the Embankment roadway.

3. The plates were cut away, and the stone lifted by hydraulic jacks and slid forward by screw traversers until it rested horizontally upon timber blocking, with its center of gravity over the center of the pedestal.

4. A wrought-iron loosely fitting jacket, 20 ft. long, with knife-edge trunnions, was riveted around the Needle and wedged up to it at either end; and a couple of box girders supporting the jacket trunnions at the center were themselves supported by wooden blocking fitted in between the six balks of timber constituting each of the four uprights of the staging which had been erected around the pedestal.

5. The box girders carrying the jacket and Needle (still horizontal) having been lifted by the hydraulic jacks, applied at the ends of the girders to the full height, the Needle was then ready for turning on the trunnions into a vertical position and lowering on to the pedestal.

In carrying out this plan of erection the first thing to be determined was the strain which could be safely put upon the Syenite monolith. There was no reason to suppose that the Needle would not be amply able to carry its own weight when balanced at its center of gravity, but it was decided to make this jacket 20 ft. long, and so limit the tensile strain to 3 cwt. per square inch—a strain which it was considered the obelisk must certainly have sustained when being handled by the Egyptians and Romans, and which it could be demonstrated the Vatican and the Paris obelisks had been subjected to during transport and erection. From experimental data it was further concluded that this strain of parts per square inch would correspond to a factor of safety of 5, hence the margin was ample to allow both for irregularity in the quality of the stone and possible dynamic strains during lifting. The strains upon the jacket were somewhat complex, and in proportioning the several parts a factor of safety of 3 was adopted.

It is satisfactory to add that the complete absence of distortion proved the accuracy of the calculations, while the knife edge carried the load of 210 tons so easily that the huge mass could be readily set rocking by hand, vibrating at the rate of 18 per minute, or two more than the Cleopatra pitched when at sea, according to the observations of Captain Carter.

The construction of the jacket and girders is fully shown in the engravings we publish this week.

A few words may be said as to the behavior at sea of the unique cylindrical ship carrying the Needle. It was within the power of the engineers to design a ship which should not roll, and they did it, for the form, distribution of weight, proportion of bilge keels, etc., were such that not a roll could be got out of the Cleopatra. It was not within their power to make a vessel which should not pitch, but they did their best to mitigate the effect by placing the cabin exactly amidships, and by making the lines very full fore and aft, although a corresponding disadvantage as regards towing and steering was entailed.

However, the little ship did all she was expected to do, and, indeed, rather more, for although the possibility of having to cast her adrift in the Bay was admitted and provided against, it was not contemplated that she would be on her beam ends with the cabin half in the water when so cast adrift.

The responsible work of superintending the erection of the Needle according to the instructions of the engineers was faithfully carried out by Mr. Double. When it is remembered that the Needle, if broken up, would constitute a full load for twenty-five railway coal trucks, and that in former days the oxen and men employed in the erection of an obelisk were numbered by hundreds and thousands respectively, it is not uninteresting to note that by the plan of erection adopted by the engineers it became possible for a single man to lift the Needle the required height of 50 ft. up into the air, while the operation throughout was, as Mr. Dixon determined from the first it should be, thoroughly characteristic of the nineteenth century and of the engineering resources of this country.—*Engineering.*

THE MOTION OF ACID ON SURFACES.

ON MOTIONS PRODUCED BY DILUTE ACID ON SOME AMALGAM SURFACES.*

By ROBERT SABINE.

WHEN a drop of dilute acid is placed upon a clean surface of a rather rich amalgam of some metal which is positive to mercury, the drop does not lie still as it would upon pure mercury, but sets itself into an irregular jerky motion. This is the case with copper, zinc, antimony, tin, and lead amalgams. But if, instead of these, platinum, gold, or silver, which are negative to mercury, be used, the drop of dilute acid remains quiet. When the experiment is made in an atmosphere of oxygen the movements are increased, but in hydrogen, carbonic acid, nitrogen, and coal gas the motions are instantly arrested. The author concludes that the motions result from the amalgam surface becoming alternately oxidized and deoxidized, thus altering the adhesion of the acid and the surface. The oxidization he believes to be due to the atmosphere. The drop on an oxidized surface expands and covers the surface, and immediately electric currents are set up within the drop between small particles of the metal suspended in the mercury, and these currents of electrolysis deoxidize the amalgam surface, which causes the drop to contract again, owing to there being less adhesion between the acid and the clean amalgam than between it and the oxidized amalgam. The clean surface being thus exposed to the air it becomes reoxidized, and this series of operations is repeated over and over again.

* Abstract of paper read before Section A of the British Association: Dublin meeting.

THE PROPERTIES OF IRON AND STEEL.*

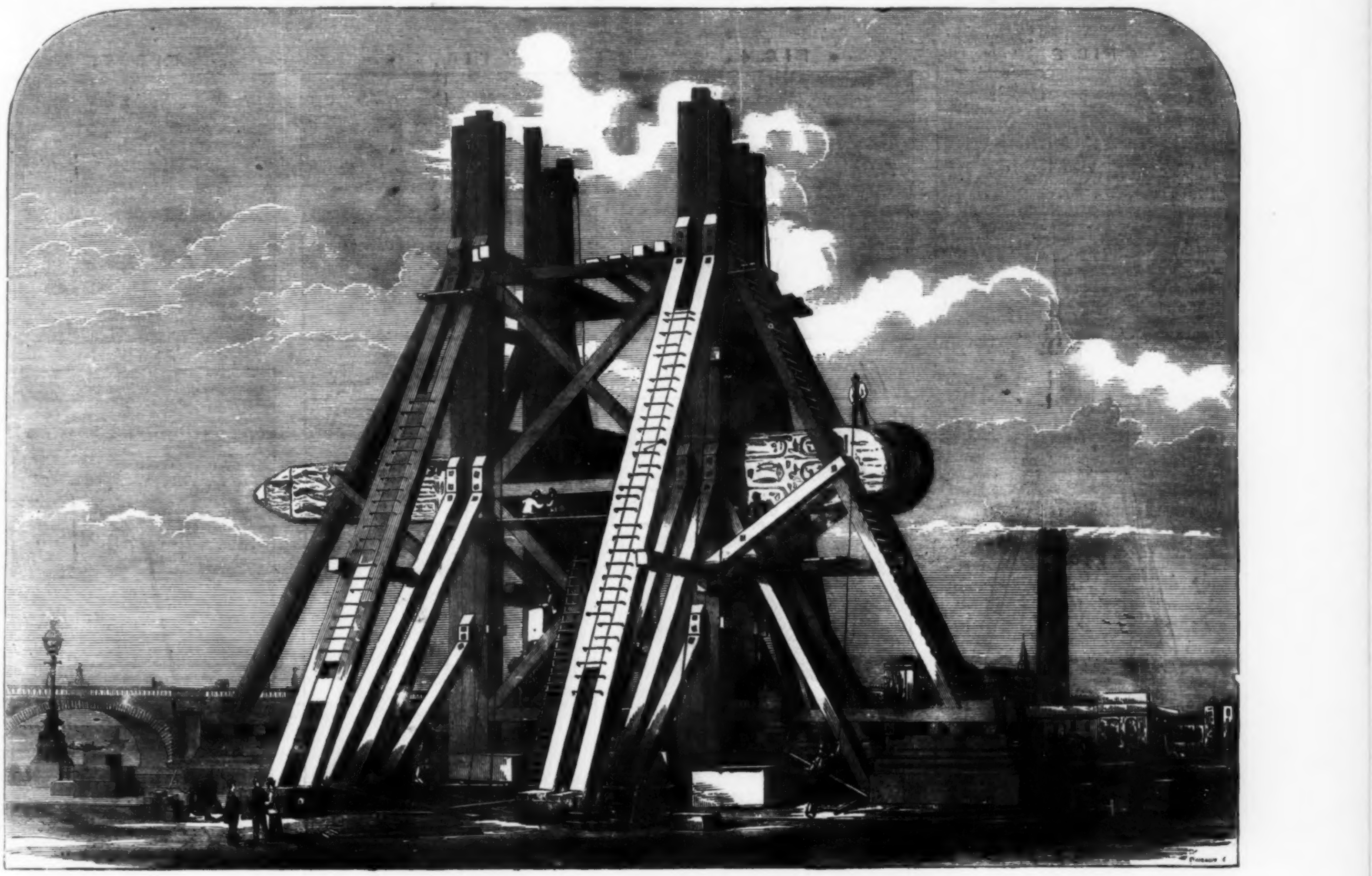
By DANIEL ADAMSON, C.E., Manchester, Eng.

NUMEROUS experiments have been conducted by several eminent engineers to prove the tensile strength of iron and steel, both in the shape of bars and plates. Unfortunately, however, many of the tests have been carried out with rude testing machines, rendering it difficult to obtain a true result of the endurance and strength of the metal under investigation. In addition to this, a large proportion of the specimens tested have been of short lengths of metal, varying from 2 ins. to 4 ins., and in all such cases a higher tensile strain has been noted than can be depended upon in practice, while the elongation has also been much overstated, a large proportion of the extension of the specimens arising from a contraction of area, or what in the present paper is called "breaking elongation." With an accurate and sensitive testing machine, the maximum load is always carried in the mild ductile metals when about five-eighths of the elongation has taken place; the remainder, down to the point of breakage, is developed with a gradually reducing load. Ordinary iron boiler plates and hard steels are an exception to this law, and nearly universally break with a maximum load, but with little or no reduction of area. The object of this paper is not simply to go over the same ground merely to prove by experiment the tensile strength of iron and steel, which would only leave us in the same condition as to the power to determine the suitability of metal for any special purpose, but to take a larger and fuller view, always having a complete record of the composition of the metal under examination. Some experiments have been conducted with this view, to determine the strength of steels with fixed proportions of carbon only, by Mr. Vickers, of Sheffield, and recorded by him in a paper read on the subject before the Mechanical Engineers of England, at Sheffield, on August 1st, 1861. Unfortunately, in this case, no cognizance was taken of other disturbing ingredients, but, as the tests in question were more especially to determine the strength of crucible steels, mostly used for tool-cutting purposes, they were of little value to the constructive or mechanical engineer to guide him in his practice. The writer having used, practically, a comparatively mild class of steels or ingot irons for the last twenty-one years, has at times found from cold mechanical bending tests some irregularities in the work of such metals, which required a more careful investigation, both as regards composition and the temperature at which they could be manipulated in the workshop and practically applied.

ENDURANCE OF IRON AND STEEL UNDER CONCUSSIVE FORCE.

One object is, to put before the members the endurance of iron and steel when subject to concussive force, such as can be produced by gun cotton, gunpowder, or other explosive materials. This is done partly with a view to understand what would be the effect on a steam boiler, working under pressure by the side of an exploding boiler, or the effect on a ship by collision with another, and whether wrought iron or steel possessed the greatest power to resist such accidentally produced force. With this object a number of experiments were conducted by the writer in the month of June, 1876, by exploding gun cotton 12 ins. above a series of iron and steel plates, varying in thickness from $\frac{3}{8}$ in. to $\frac{7}{16}$ in. The iron plates tested were of best quality, the steel plates of a mild class suitable for boiler and shipbuilding purposes. All the

* A paper read before the Iron and Steel Institute, Paris meeting, Sept., 1878.—*The Engineer.*



RAISING THE CLEOPATRA NEEDLE, LONDON, AUGUST, 1878.

Iron plates subject to explosive test were 18 ins. square by $\frac{7}{16}$ in. thick, placed upon a cast-iron anvil block, about 20 ins. square, having a segment of a sphere gouged out on the top side, 10 ins. diameter and 4 ins. deep; 12 ins. above the plate 3 lbs. of damp gun cotton were fixed by a tripod of laths, Fig. 1, attached to the cotton by two India-rubber rings. Again, upon this was placed 2 ozs. of dry gun cotton with a time fuse attached, to insure a complete explosion of the damp compressed cotton. On the gun-cotton exploding, the iron plate was entirely broken through 10 ins. in diameter, and the center piece forced down to the bottom of the anvil block breaking up in an irregular line in the direction of the fiber, and to some extent across it, as illustrated by Fig. 2. The same experiment, precisely, was conducted on a steel boiler plate, but only ½ in. thick. The steel plate after the explosion, with the same weight of gun cotton, and under exactly similar arrangements, was depressed 3 ins. into the recess of the anvil block without the slightest sign of fracture or any apparent injury whatever. So far these experiments were conclusive in favor of mild steel to resist violent concussive force.

THIRTY EXPERIMENTS UPON PLATES.

With a view to get a full and more exact knowledge of the reasons why the iron plates broke up so much, as compared with the mild steels, a further series of thirty experiments were carried out in September, 1877, operating upon twenty-seven plates of varying quality, selected from the principal manufacturing districts—the iron plates of best and best-best boiler quality from Staffordshire, Shropshire, and Yorkshire, including the Lowmoor class—the steel plates both from the Bessemer and Martin-Siemens class of makers. The composition of each plate is shown on Table A, with figured references. A number of the plates experimented upon are illustrated, beginning with Fig. 3, and ending at Fig. 13. The annealed mild steels again show a marked superiority of endurance. The remainder of the illustrations are iron boiler plates of different qualities, the respective analyses of which are given on Table A. In the case of the first twenty-seven tests the charge of gun cotton was reduced to 1½ lb., but being exploded 9 ins. above the plate, instead of 12 ins., as in the first tests. Attention may be further called to plates which at the first explosion were dished down into the anvil about 1¾ in., after which the plates were turned with the convex side up, and a further charge of 1½ lb. of gun cotton was exploded 7¼ ins. above the crown of the plates, producing thereby a double corrugation, without the plates exhibiting any outward signs of distress or injury.

ANNEALED STEEL.

The mild steel thus showed powers of resisting concussive force, probably unequaled by any other metal that has ever been manufactured. The two plates now referred to had both been annealed previous to the first explosion, and the need of such annealing is illustrated by one steel plate, which cracked and broke up by the explosion, the broken plate being forced down to the bottom of the dish in the anvil. The writer is not aware how this plate was made, but the composition shows a very good quality of mild steel. The plate from its appearance had evidently been finished from the rolls at a low heat, and had a fine, smooth oxide steel surface. The necessity of annealing was further shown by the same class of plate experimented upon, after being tempered in oil and afterward annealed, which confirms the writer's opinion that it is indispensable to anneal steel plates, as stated by him at a meeting of the Mechanical Engineers of England, at Sheffield, on July 31st, 1861, in the discussion of a paper read by Mr. Bessemer, on what was then considered a new metal, or Bessemer steel.

Before leaving the subject of the endurance of steel to resist concussive force, the writer would draw attention to Figs. 3 and 4, from which it will be observed that a steel plate was ruptured or split by the explosion. The cause of this was not known or understood until a full analysis was secured, when it was discovered that the plate in question contained about three times as much both sulphur and phosphorus as is common to an average good Bessemer or Martin-Siemens mild steel boiler plate. This experiment will probably explain why some breakages have occurred in the use of steel plates for boiler purposes, simply because the metal was of inferior quality, and establishes the need of a careful investigation into the character of the metal an engineer may select for practical purposes.

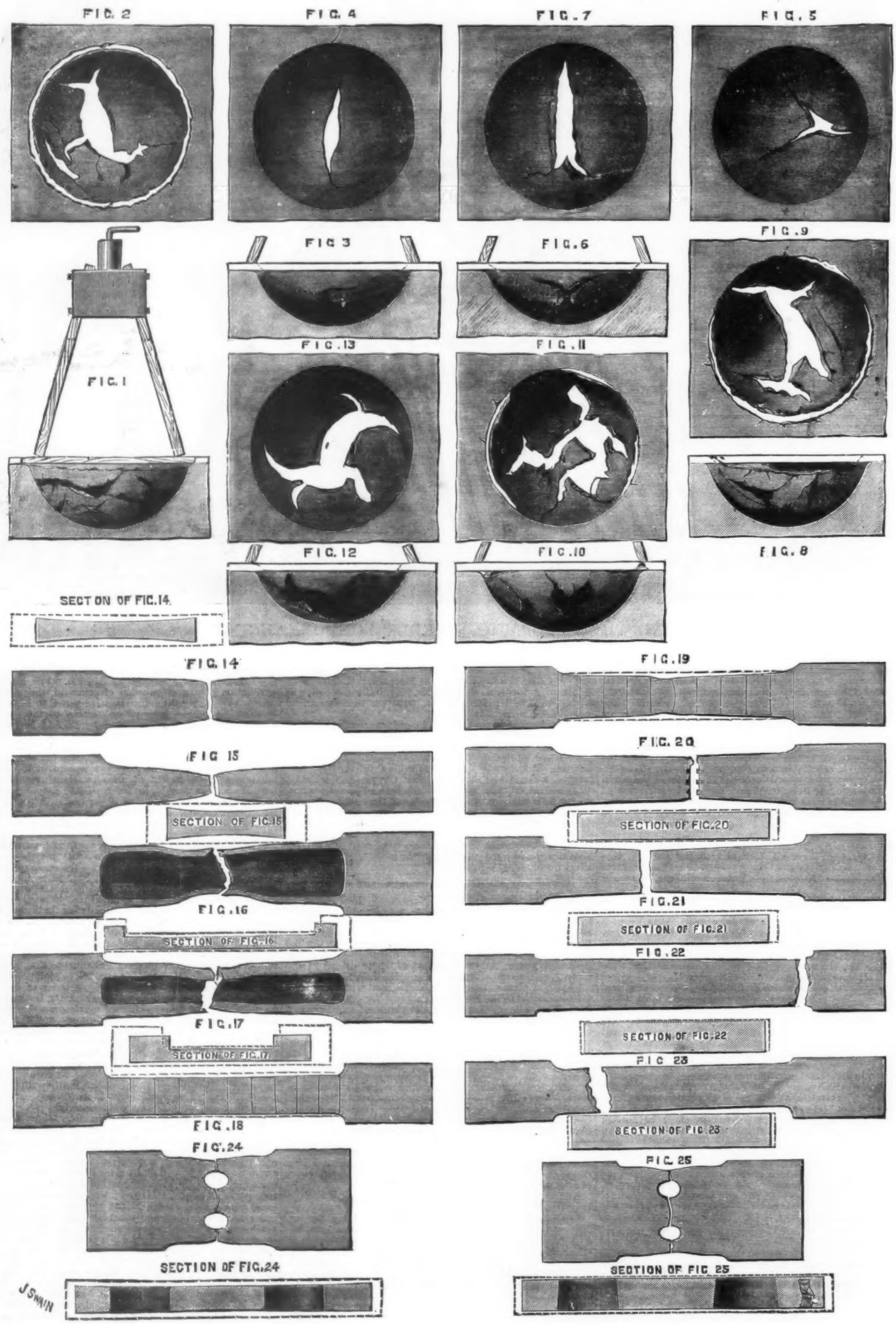
EFFECTS OF SULPHUR, PHOSPHORUS, AND CINDER.

The leading feature of the rupture of the iron plates, in the whole series of the experiments, may be said to closely follow in destruction, the quantity of sulphur, phosphorus, and cinder contained in the metal. See Table A for analysis. Further experiments were conducted with a view to test the iron and steel plates in question by drifting a washer cut from each plate. All the washers had a hole drilled in the center, equal to the diameter of a rivet hole for the same thickness of plate as used by the writer, and with an outside diameter equal to the lap of such a plate for single riveted joint. The ordinary best-best boiler plates, of varying qualities, show an extension in the diameter of the hole, by drifting from 27 per cent. up to 50 per cent., while the best high-class Yorkshire plates endured drifting up to 91·5 per cent. before bursting. Specimens produced. Passing on to the drift tests of the mild steel plates, the holes being $\frac{1}{32}$ smaller to begin with, or $\frac{5}{8}$ $\frac{1}{32}$, the outside diameter being proportionately less, agreeing with the thickness of the plates, the enlargement of the holes by drifting range from 133 per cent. to 187 per cent. These drift tests further illustrate the necessity of annealing. The composition of the two mild steel plates that withstood the highest drift test both show a low measure of carbon, but one plate had slightly less phosphorus than another plate, and only a quarter as much sulphur, thus, to some extent, explaining chemically that a higher endurance of drifting test is secured by the lowest measure of sulphur and phosphorus.

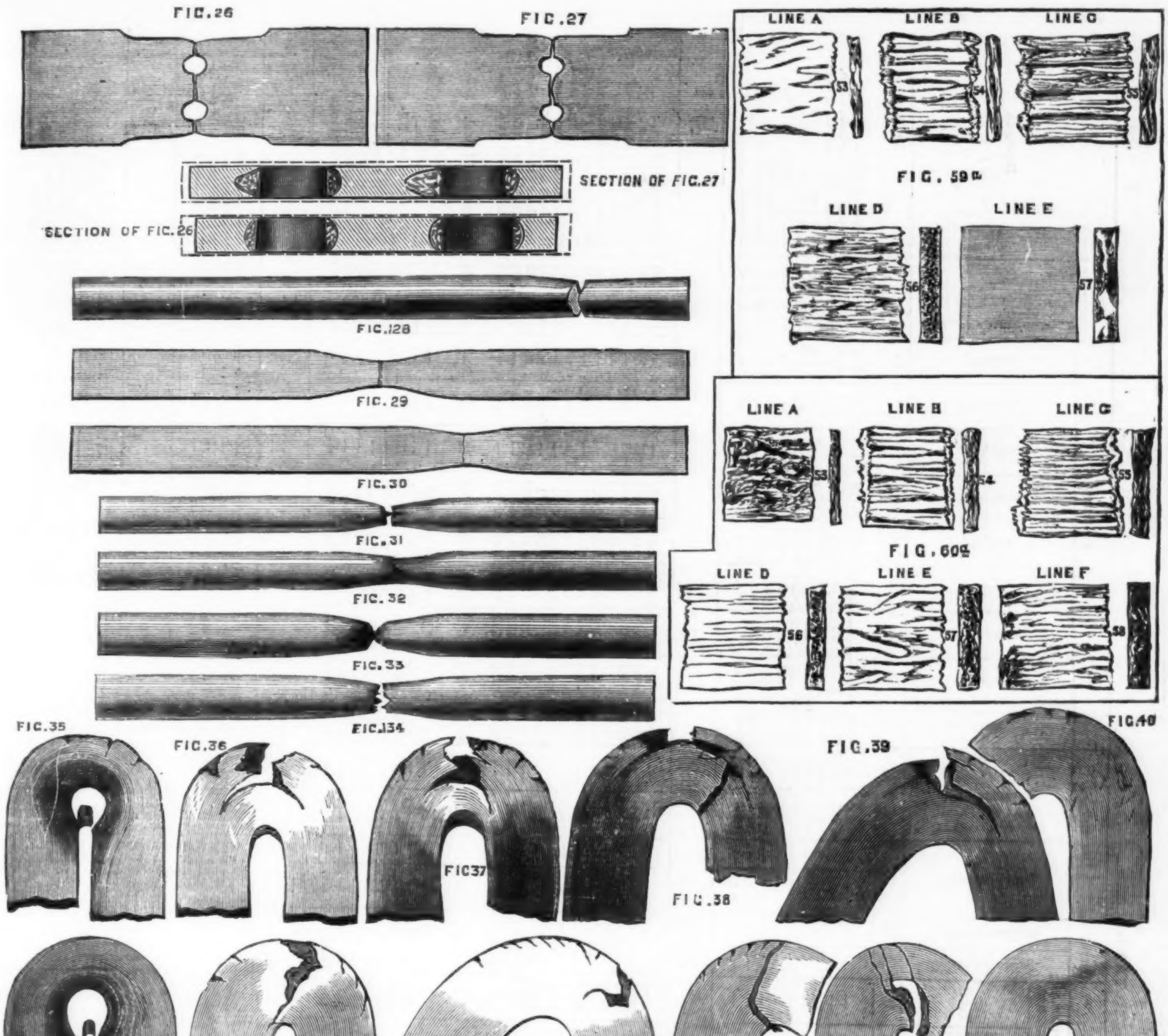
TENSILE STRENGTH OF IRON AND STEEL.

Innumerable records have been published giving the tensile strength of iron and steel; the quality, as a rule, has only been defined by the maker's name being attached to it, without any thought or care as to what the metal was composed of. Great discrepancies have arisen, and according to Mr. Kirkaldy, in his published records, 1862, of an almost bewildering number of tests, which were carried out by him when he was with Messrs. Robert Napier & Sons, of Glasgow, between the years 1859 and 1861. It is stated on page 94, paragraph 50, being a summary of conditions, that "The startling discrepancy between experiments made at the Royal Arsenal, and by the writer (Mr. Kirkaldy), is due to the difference in the shape of the respective specimens, and not to the difference in the two testing machines." A record of the experiments illustrated on the following pages clearly disproves and sets aside this conclusion, while a fuller investigation of the constituent elements of the metal will plainly explain the difference that is reputed to have arisen, by the variation in the shape or sections of the specimens tested. The specimen illustrated by Fig. 14 is a piece of mild steel boiler plate of average good quality, as will be noted from the analysis recorded on Table A. This is fully borne out by the mechanical test, a permanent set being induced by a strain of 19·86 tons per square inch, carried a maximum load of 29·91 tons, with an elongation of 15 per cent., and ultimately broke down with 25·89 tons per square inch, and a total elongation of 26 per cent. After the maximum load had been carried the specimen began to reduce in sectional area about the middle for a distance of from 2 ins. to 3 ins., carrying less and less load as it elongated, until final destruction took place at about 26 tons. The carrying power is about the average of what may be called a very mild steel boiler plate, and from the composition such might be expected. The specimen, Fig. 15, is taken to illustrate the carrying power on a plain rectangular section of steel boiler plate, near a square inch, in sectional area, but which is not of the highest quality, as indicated by the quantity of sulphur and phosphorus it contains, but to secure a standard force to break this class of metal, with irregular sections. See analysis, Table B. Figs. 16 and 17 are cut from the same plate, and are of the same composition, but planed out to produce a channel section, as shown, being increased or decreased in breadth to maintain the section equal to about one square inch. A series of tests were made with variable sections of this character, but practically no difference was found—after the maximum strain had been taken—arising from the difference in form, and this will be seen from specimens tested which carried a maximum load of 27·72 tons. Fig. 16, carrying 27·7 tons, and Fig. 17, that carried 27·8 tons, per square inch, these, together with more tests by the writer on round, square, and rectangular bars, all show that varying sections do not alter the carrying power; the disturbing influence being entirely that of composition, coupled, no doubt, with more or less careful manipulation and work put upon the material.

In making tensile tests of this character, short specimens of 2 ins. to 4 ins. are inadmissible, and at best misdirecting. The mild steel specimen, Fig. 18, had its surface rough polished, over the 10 ins. under test and divided off into ten equal parts; this test, was carried on until the maximum strain was upon it, and by its elongation showed it to be of a very mild quality, requiring to induce permanent set 16·96 tons per square inch, and carrying a maximum load of 27·67 tons, with a total elongation of 18·5 per cent. The load was now removed to leave the plate unbroken. Specimen produced, and its composition shown on Table B. The elongation of each separate inch is recorded on the drawing, and, reading from the left hand, we find the first inch elongated 14 per cent., the second inch 17 per cent., third inch 19 per cent., fourth inch 21 per cent., the fifth inch, arriving at the middle of the specimen, 23 per cent., the seventh 20 per cent., the eighth 17 per cent., and the ninth 17 per cent., or the same as the second inch, while the tenth elongated 14 per cent., being the same comparative position as regards ends as the first inch, and also the same elongation. A similar plate, Fig. 19, and of the same composition, was next operated upon, the permanent set taking place with 16·96 tons, maximum endurance 27·45 tons per square inch,



THE PROPERTIES OF IRON AND MILD STEEL.



THE PROPERTIES OF IRON AND MILD STEEL.

THE PROPERTIES OF IRON AND MILD STEEL.

TABLE A.

Figs.		Material.	Mechanical Tests. Size of specimen. Length. (1)	Breadth. (2)	Thickness. (3)	Area. (4)	Fractured area. (5)	Permanent set induced per sq. in. In lbs. (6)	In tons. (7)	Maximum strain per sq. in. In lbs. (8)	In tons. (9)	Per cent. of elongation when maximum strain is applied. (10)	Final breaking strain on original area per sq. in. In lbs. (11)	In tons. (12)	Length of total breaking elongation. (13)	Per cent. of elongation. Due to local elongation. (14)	Total. (15)	Bending. Before annealing. (16)	After annealing. (17)	Drifting. Before annealing. (18) From	To	After annealing. (19) From	To	Composed of Iron. (20)	Carbon. (21)	Manganese. (22)	Silicon. (23)	Sulphur. (24)	Phosphorus. (25)	Copper. (26)	Oxygen. (27)	Cinder. (28)	(29)			Remarks. (30)
5, 6	A	Steel...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·656	1·457	99·00	0·137	0·634	0·018	0·126	0·154	0·004	—	Nil.	—	A	C	Bessemer mild steel.
7, 8	B	Iron	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·687	1·3125	98·90	Trace	0·18	0·13	Nil.	0·13	—	—	—	—	B	W	Special class Yorkshire iron.
9, 10	C	Iron	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·687	1·3125	98·90	Trace	0·14	0·14	Trace	0·17	—	—	—	—	C	ɿ	Special class Lancashire iron.
11, 12	D	Iron	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·687	1·093	99·000	0·035	0·029	0·075	0·011	0·300	0·022	0·528	2·112	—	D	D	Best best boiler plate.
13, 14	E	Iron	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·687	·968	99·000	0·040	0·029	0·094	0·011	0·306	0·024	0·496	1·984	—	E	E	Best best boiler-plate.
15, 16	F	Steel...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·656	1·781	99·100	0·145	0·576	0·018	0·063	0·085	0·012	—	—	—	F	M	Martin-Siemens mild steel.
17, 18	G	Steel...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·656	1·625	99·00	0·16	0·61	0·04	0·08	0·04	—	—	—	—	G	P	Crumble steel.
19, 20	H	Steel...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·656	1·875	99·25	0·14	0·36	0·06	0·05	0·04	—	—	—	—	H	T	Bessemer class mild steel.
21, 22	I	Steel...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·656	1·531	99·00	0·13	0·77	0·02	0·11	0·04	—	—	—	—	I	Z²	Pot steel.

TABLE B.

Figs.		Material.	Length. (1)	Breadth. (2)	Thickness. (3)	Area. (4)	Fractured area. (5)	Permanent set In lbs. (6)	In tons. (7)	Maximum strain In lbs. (8)	In tons. (9)	(10)	Final breaking strain In lbs. (11)	In tons. (12)	(13)	(14)	Total. (15)	(16)	(17)	(18) From	To	(19) From	To	Iron. (20)	Carbon. (21)	Manganese. (22)	Silicon. (23)	Sulphur. (24)	Phosphorus. (25)	Copper. (26)	Oxygen. (27)	Cinder. (28)	(29)			Remarks. (30)
23	A	Steel...	10	2·66	·375	1·0	—	44500	19·86	67000	29·91	15·0	58000	25·89	—	—	26·0	—	—	—	—	—	—	99·3	0·13	0·468	0·023	0·031	0·037	—	—	—	—	A	121	Bessemer mild steel.
24	B	Steel...	10	2·0	·475	·95	—	43684	19·5	62105	27·72	19·0	52105	23·25	—	—	24·0	—	—	—	—	—	—	99·057	0·082	0·68	0·005	0·100	0·056	0·02	—	—	—	B	138	Bessemer mild steel.
25	C	Steel...	10	Channelled		·91875	—	43537	19·43	62040	27·7	16·0	55512	24·78	—	—	21·0	—	—	—	—	—	—	99·057	0·082	0·68	0·005	0·100	0·056	0·02	—	—	—	C	139	Bessemer mild steel.
26	D	Steel...	10	Channelled		·93125	—	45106	20·13	62281	27·8	17·5	55302	24·68	—	—	24·0	—	—	—	—	—	—	99·057	0·082	0·68	0·005	0·100	0·056	0·02	—	—	—	D	144	Bessemer mild steel.
27	E	Steel...	10	2·35	·425	1·0	—	38000	16·96	62000	27·67	18·5	—	—	—	—	—	—	—	—	—	—	—	99·397	0·180	0·284	0·042	0·007	0·090	—	—	—	—	E	234	Sub-carbonised mild steel.
28	F	Steel...	10	2·35	·425	1·0	—	38000	16·96	61500	27·45	18·5	57000	25·4	—	—	25·0	—	—	—	—	—	—	99·397	0·180	0·284	0·042	0·007	0·090	—	—	—	—	F	235	Sub-carbonised mild steel.
29	G	Steel...	8	2·66	·375	1·0	—	60400	26·96	120000	53·57	14·5	120000	53·57	—	—	14·5	—	—	—	—	·656	1·24	98·4	0·410	1·080	0·055	0·031	0·051	Trace	—	—	—	G	243	Bessemer medium hard steel.
30	H	Iron	10	2·66	·375	1·0	—	37500	16·74	57000	25·4	14·0	57000	25·4	—	—	18·0	—	—	—	—	—	—	98·9	Trace	0·18	0·13	Nil.	0·03	—	—	—	—	H	176	Special class Yorkshire iron.
31	I	Iron	10	2·35	·425	1·0	—	37500	16·75	55000	24·55	15·5	55000	24·55	—	—	15·5	—	—	—	—	—	—	99·2	0·04	0·17	0·15	0·03	0·21	—	0·20	0·80	—	I	169	Best best boiler-plate.
32	K	Iron	10	2·38	·42	1·0	—	35481	15·84	45696	20·4	5·75	45696	20·4	—	—	5·75	—	—	—	—	—	—	98·8	0·045	0·086	0·186	0·012	0·208	0·005	0·658	2·63	—	K	82	Best best Shropshire boiler-plate.
34	L	Steel...	Drilled		·4375	1·093	—	39066	17·43	63677	28·43	—	63677	28·43	—	—	—	—	—	—	—	—	—	99·254	0·220	0·432	0·011	0·041	0·042	—	—	—	—	L	207	Martin-Siemens mild steel.
35	M	Steel...	Punched		·4375	1·093	—	38426	17·15	49040	21·89	—	49040	21·89	—	—	—	—	—	—	—	—	—	99·254	0·220	0·432	0·011	0·041	0·042	—	—	—	—	M	206	Martin-Siemens mild steel.
36	N	Steel...	Punched and afterwards annealed		·375	·80	—	55952	24·97	55952	24·97	—	55952	24·97	—	—	—	—	—	—	—	—	—	99·057	0·082	0·68	0·005	0·100	0·056	0·02	—	—	—	N	181	Bessemer mild steel.
37	O	Steel...	Punched		·375	·89	—	50184	22·40	50184	22·40	—	50184	22·40	—	—	—	—	—	—	—	—	—	99·16	0·065	0·61	0·084	0·056	0·02	—	—	—	—	O	180	Bessemer mild steel.
38	P	Bar iron	10	1in.	diam.	·7854	—	36287	16·19	53476	23·87	18·0	50929	22·73	—	—	20·5	—	—	—	—	—	—	99·44	Trace	0·10	0·16	0·01	0·29	—	—	—	—	P	226	Cleveland bar iron.
39	Q	Bar iron	5	1	1	1·0	—	25200	11·25	43600	19·46	33·0	29000	12·94	—	—	39·0	—	—	—	—	—	—	99·8	0·023	Trace	0·037	0·013	0·033	0·003	0·091	—	—	Q	191	Special class bar iron.
40	R	Bar iron	10	·90	·90	·810	—	27777	12·3	44074	19·64	20·0	29753	13·27	—	—	23·5	—	—	—	—	—	—	99·8	0·04	0·14	0·04	0·02	0·03	—	—	Nil.	—	R	270	Swedish bar iron.
41	S	Rivet steel	5	$\frac{11}{16}$in.	diam.	·3712	—	52262	23·33	76778	34·27	28·5	60614	27·05	—	—	34·0	—	—	—	—	—	—	99·25	0·12	0·49	0·02	0·08	0·04	—	—	—	—	S	110	Mild rivet steel.
42	T	Rivet steel	5	$\frac{11}{16}$in.	,,	·3712	—	53340	23·81	78394	34·99	18·5	53906	24·06	—	—	33·5	—	—	—	—	—	—	99·25	0·12	0·49	0·02	0·08	0·04	—	—	—	—	T	109	Mild rivet steel.
43	U	Rivet iron	5	$\frac{7}{8}$in.	,,	·6013	—	39913	17·81	54881	24·5	16·5	50723	22·64	—	—	28·5	—	—	—	—	—	—	99·49	Trace	0·10	0·19	0·02	0·2	—	—	—	—	U	108	Special class rivet iron.
44	V	Rivet iron	5	$\frac{7}{8}$in.	,,	·6013	—	39913	17·81	56544	25·24	18·5	49890	22·27	—	—	33·0	—	—	—	—	—	—	98·9	Trace	0·125	0·196	Trace	0·211	—	—	—	—	V	107	Special class rivet iron.

TABLE C.

Figs.		Material.	Length. (1)	Breadth. (2)	Thickness. (3)	Area. (4)	Fractured area. (5)	Permanent set In lbs. (6)	In tons. (7)	Maximum strain In lbs. (8)	In tons. (9)	(10)	Final breaking strain In lbs. (11)	In tons. (12)	(13)	(14)	Total. (15)	(16)	(17)	(18) From	To	(19) From	To	Iron. (20)	Carbon. (21)	Manganese. (22)	Silicon. (23)	Sulphur. (24)	Phosphorus. (25)	Copper. (26)	Oxygen. (27)	Cinder. (28)	(29)			Remarks. (30)
47	A	Bar iron	5	$1\frac{1}{8}$in.	diam.	·994	—	35000	15·62	56000	25·01	20·0	51500	23·0	—	—	27·0	—	—	—	—	—	—	98·389	0·063	0·204	0·206	0·018	0·334	—	—	0·880	—	A	186	Best merchant iron.
48	B	Steel...	10	2·66	·375	1·0	—	36500	16·29	62000	27·67	19·0	52500	23·43	—	—	30·0	—	—	—	—	—	—	99·38	0·170	0·296	0·042	0·009	0·104	—	—	—	—	B	231	Sub-carbonised mild steel.
49	C	Steel...	10	2·06	·485	1·0	—	34500	15·4	59500	26·56	16·5	50500	22·54	—	—	27·0	—	—	—	—	—	—	99·224	0·200	0·500	0·009	0·035	0·032	—	—	—	—	C	220	Martin-Siemens mild steel.
50	D	Bar iron	5	1	1	1·0	—	26500	11·83	44000	19·64	24·0	28500	12·72	—	—	34·0	—	—	—	—	—	—	99·8	0·023	Trace	0·037	0·013	0·033	—	—	—	—	D	190	Special class bar iron.

TABLE D.

Figs.		Material.	Length. (1)	Breadth. (2)	Thickness. (3)	Area. (4)	Fractured area. (5)	Permanent set In lbs. (6)	In tons. (7)	Maximum strain In lbs. (8)	In tons. (9)	(10)	Final breaking strain In lbs. (11)	In tons. (12)	(13)	(14)	Total. (15)	(16)	(17)	(18) From	To	(19) From	To	Iron. (20)	Carbon. (21)	Manganese. (22)	Silicon. (23)	Sulphur. (24)	Phosphorus. (25)	Copper. (26)	Oxygen. (27)	Cinder. (28)	(29)			Remarks. (30)
53	A	Common iron... ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	98·8	Trace	Trace	0·177	0·008	0·523	Nil.	—	—	—	A	—	Common iron.
54	B	Tudhoe crown iron.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	98·90	Trace	Trace	0·107	Trace	0·217	Nil.	—	—	—	B	—	Tudhoe crown iron.
55	C	Tudhoe best best ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	99·00	Trace	0·216	0·111	Trace	0·165	Nil.	—	—	—	C	—	Tudhoe best best iron.
56	D	Medium hard steel.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	98·40	0·330	1·008	0·065	0·022	0·075	Trace	—	—	—	D	—	Medium hard steel.
57	E	Mild steel	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	99·354	0·115	0·504	0·055	0·028	0·037	Trace	—	—	—	E	—	Bessemer mild steel.
58	F	Pure iron.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	99·900	Nil.	Nil.	Slight trace	Slight trace	0·040	Nil.	—	—	—	F	—	Pure iron.

with an elongation of 18·5, and being the same as the preceding test, within the most trivial fraction; the test was continued until the elongation reached 25 per cent., with a carrying load of 25·4 tons per square inch.

Without going through each inch, as in the preceding specimen, it will be seen, with a test of an elastic sample of this character for a few inches, that a very large measure of the elongation is due after the maximum load had been carried, and which is called the breaking elongation, while the power to carry an undue load is illustrated by the small elongation at the two end inches, as supported by the stronger portions of the specimen that are in the grip boxes of the testing machine. Fig. 20 is a specimen of a much more highly carbonized steel, evidently well adapted for the bottom flanges of girders of bridges, or for suspension chains of bridges, as over several tests a noteworthy fact is that great uniformity has been proved. The original area of the specimen being one square inch, permanent set was induced by 26·96 tons; it carried a maximum load of 53·57 tons, and elongated 14·5 per cent., being an elongation equal to the best boiler plate iron, and carrying a load to induce permanent set, just about equal to the full carrying power of the best Yorkshire boiler plates, thus showing that metal with about half per cent. of carbon, 1 per cent. of manganese, with a low measure of silicon, sulphur, and phosphorus, can be depended upon to carry double the load of the best wrought-iron plates that can be produced, and with as much dependence, as regards elongation.

In the drift test of the same specimen, being of the same proportion as those previously described, the hole increased 89 per cent. in diameter. The power of this metal, to endure enlargement by drifting, may also be classified with the best iron boiler plate; the steel withstood 89 per cent., as against 91½ per cent. of the drift test of the best Yorkshire boiler plate of the same size and thickness. Fig. 21 is a specimen of the best Yorkshire boiler plate, the mechanical powers of which are as follows: To induce permanent set it required 16·74 tons, carried a maximum load of 25·4 tons, with an elongation of 14 per cent. maximum and breaking load being the same; the ultimate stretch or elongation was 18 per cent. or 4 per cent. increase, after beginning to carry the maximum weight. This, like all other plate iron specimens, breaks under a maximum load, with a moderate elongation, and with no warning as compared with mild steels. The composition of this metal is stated on Table B, from which it will be seen to be a high-class iron, by the absence of sulphur and the small measure of phosphorus, and is supposed to contain only about 2·4 per cent. of cinder. This specimen was tested with the grain, or in the direction the plate had been rolled. Fig. 22 illustrates a specimen of best-best boiler plate, tested in the direction of the grain; the composition of same is recorded on Table B, and shows a small measure of carbon. Permanent set was induced by 16·74 tons, carried a maximum load of 24·55 tons, with an elongation of 15½ per cent., and then broke down suddenly with the full weight. Fig. 23 is a specimen of a boiler plate much used in Lancashire, that was tested with the grain; the composition, as given on Table B, shows the plate to be milder than the last, and it has a lower measure of alloying ingredients. Permanent set was induced by 15·84 tons, carried a maximum weight of 20·4 tons, with an elongation of 5·75 per cent. On the load being continued a short while, the specimen broke suddenly without further elongation. This plate ought to have carried much more had it not contained about 3·54 per cent. of cinder.

DRILLED AND PUNCHED HOLES.

The specimen, Fig. 24, was pulled asunder, having two drilled holes, and the specimen, Fig. 25, is the same in every respect, except that it had punched holes. The plate with drilled holes required to produce permanent set, through line of the holes, 17·43 tons per square inch of plate left, carried a maximum load of 28·43 tons, with an elongation in the hole of 56·66 per cent., breaking through without further change, with the full weight. The plate with the punched holes required to produce permanent set, 17·15 tons per square inch, or about the same as the preceding one, but only carried a load of 21·89 tons, breaking suddenly through without warning, with a loss of 29·8 per cent. in strength, and of elongation of 33·33 per cent. through punching. This plate was not annealed after punching. The fracture in punched plate shows some crystallization. The drilled plates carry a somewhat higher tensile strain through the line of hole, as a rule, in proportion to the sectional area of the metal left, than a solid section of plate, no doubt, the circle of the holes supporting the smallest section through their center line. Numerous experiments have been conducted with a view to ascertain the force required to punch holes through a given thickness of plate, but without taking cognizance of the quality of the metal.

RULE TO FIND THE POWER REQUIRED TO PUNCH STEEL PLATES.

To punch a hole through a steel plate, equal to a sectional inch of detruding area, may be found by multiplying the maximum tensile strength, per square inch, by 0·74, of the same metal, which will give the force required—the detruded area, meaning the circumference of the punch, multiplied by the thickness of the plate. This law may be depended upon both for the soft and the hard steels, and the total force to punch a hole through a hard plate, as compared with a soft one, may be said to accurately follow the law of its maximum tensile carrying power, so that a strong steel requires exactly a proportionate increase of force to punch a hole through a given thickness of plate as it does to pull it asunder.

Fig. 28 represents a round bar of Cleveland iron, 1 inch diameter, length under test being 10 inches. Permanent set was induced by 16·19 tons, carried a maximum load of 23·87 tons, with an elongation of 18 per cent., and finally broke down with 22·73 tons per square inch, and a total elongation of 20·5 per cent. Fig. 29 is a specimen of 1 inch square bar of Lancashire iron made out of special brands of cast irons, carefully selected from English and foreign productions. The purity of this iron is remarkable, as shown by its analysis, Table B, while its mechanical behavior was equally singular, only requiring to produce permanent set 11·25 tons, carried a maximum load of 19·46 tons, with an elongation of 33 per cent., and broke with a strain of only 12·94 tons per square inch, and a total elongation of 39 per cent. This metal being singularly pure, further attention will be called to it to show its great endurance over a large range of working temperature. Fig. 30 is a specimen of Swedish bar iron tested over 10 inches in length, and lined off into separate inches, same as Figs. 27 and 28, to further illustrate the peculiar behavior of a ductile metal. Permanent set was produced by 12·3 tons per square inch, carried a maximum load of 19·64 tons, having then stretched 20 per cent., broke down with 13·27 tons, and a total elongation of 23·5 per cent.

THE TEN-INCH TEST.

Had this bar been tested over a length of 2 inches only the total elongation would most probably have been registered by the two middle inches where the bar pulled asunder, which stretched in themselves 46·25 per cent., while the two end inches only elongated 14·5 per cent., thus showing that the two middle inches stretched 31·75 per cent. more than the two end inches, and 22·75 per cent. more than the average of the whole 10 inches. Besides that an undue elongation must be recorded with a short specimen, it is more than probable that a much higher strain would have been carried before the maximum load was attained. The 10-inch length was adopted by the writer with a view to neutralize the extreme elongation caused by what is now pronounced as the breaking elongation, besides with a moderate length there is a greater probability of an accurate record being secured of the exact carrying power of the metal. The 10-inch length also gives facility for a simple division into one hundred parts, and by fixing a scale on the testing machine the elongation per cent. can be easily and accurately read off therefrom. Figs. 31 and 32 are illustrations of $\frac{11}{16}$ inch mild steel bars, as largely used by the writer for rivets, and is of boiler-plate type of metal, but with more work put upon it to make into bars; Fig. 31 required 23·33 tons to produce permanent set, carried a maximum load of 34·27 tons, with an elongation of 28·5 per cent., finally breaking with 27·05 tons per square inch, with a total elongation of 34 per cent. on the 10-inch length. Specimen, Fig. 32, required 23·81 tons to induce permanent set, carried a maximum load of 34·99 tons, with an elongation of 18·5 per cent. breaking down with 24·06 tons, and having a total elongation of 33·5 per cent., showing a very great difference to exist in the powers of endurance between the carrying load of a mild steel and a comparatively pure wrought iron; yet the steel elongates nearly as much as the soft metal, illustrating in every way the greater powers of endurance of a mild cast steel or ingot iron over a puddled pure wrought-iron bar. Compositions recorded on Table B.

Specimens of ⅞ inch round rivet iron, specially made for and used by the writer, were tested same as the preceding. Specimen, Fig. 33, requiring to produce permanent set 17·81 tons, carried a maximum load of 24·5 tons, with an elongation of 16·5 per cent. and a final breaking load of 22·64 tons per square inch, with a total elongation of 28·5 per cent. Specimen, Fig. 34, required 17·81 tons to produce permanent set, carried a maximum load of 25·24, with an elongation of 18·5 per cent. and a breaking load of 22·27 tons, the total elongation being 33 per cent. These bars are shown to be comparatively high-class irons, possessing a moderately full tensile strength, with great elongation and endurance.

The writer in a large practice has proved such iron to be a very safe metal for rivet purposes, in fact, a rivet-head has not been known to break off in the manufacture of several hundred boilers.

WELDING OF STEEL BOILER PLATES.

After many trials and many failures in attempting to weld steel boiler plates, the writer found it necessary to ascertain in all cases the composition of the metal before putting any labor upon it, and from a large experience it is now considered desirable that the carbon should not exceed one-eighth of a per cent., while the sulphur and phosphorus should, if possible, be kept as low as ·04, silicon being admissible up to the extent of a tenth of a per cent. Further experience is yet required to ascertain what exact composition gives the most satisfactory results by welding. At present some preference may be said to be given to the Martin-Siemens class as compared with Bessemer metal, when both are of about the same chemical composition. Few or no malleable metals, such as wrought iron or mild steels, can be found in the open market that possess a range of endurance at all varying temperatures, say, from cold up to red heat, but nearly all ordinary bar or boiler iron and mild steels will endure considerable percussive force when cold, and up to 450° Fah., after which, as the heat is increased, probably to near 700°, they are all more or less treacherous and liable to break up suddenly by percussive action. The poorer class of metals at this temperature, which may be called a color heat, varying from a light straw to a purple and dark blue, are simply rotten. Some of these peculiar properties are illustrated by a series of tests of various qualities of metal.

The ordinary merchant iron, illustrated by Fig. 35, shows that it may be bent cold, or may be bent red hot without signs of breakage or much distress. The two outside illustrations of the Figs. 35 and 52 endure this bending test when cold and when red hot, but at such a heat as can be induced by placing the metal into a bath of boiling tallow registering a temperature of about 610° Fah., these metals break through by being bent, lose most of their malleability and snap off short under the action of the hammer.

The same unfortunate element is exhibited by the mild class of Bessemer and Martin-Siemens steel, with this difference, that they bent better cold, and more pleasantly when hot, but both break up by percussive action at the medium temperature before named, the Martin-Siemens enduring somewhat better than the Bessemer class under these tests. All the mechanical properties of these metals and their chemical compositions are shown by Table C, on reference to which it will be seen that the test, Figs. 53 to 58, not only bent well cold and red hot, but also at every intermediate heat at which the merchant iron and the mild steels failed.

During several years of observation the writer has come to the conclusion that no metal, containing much above a trace of sulphur, can endure bending at this color heat, while, at the same time, the phosphorus must be low; in fact, such endurance can only be obtained by a comparatively pure iron unalloyed by any other ingredients. The specimens of iron and steel, showing color heat, induced by boiling tallow, exhibited. Of Fig. 50, the mechanical power of this metal may again be referred to, that it only supported 11·83 tons to produce permanent set, carried the low maximum strain of 19·64 tons, but by this force it had elongated 24 per cent., yet ultimately stretched 39 per cent., and broke with 12·72 tons per sectional inch of original area, clearly establishing that with a comparatively pure iron to secure great ductility and malleability you only have a low carrying power. The writer had a further object in testing the round bars of Cleveland iron with a view to examine their powers of endurance at this color heat, but it was found not necessary to illustrate any specimens, as the metal unfortunately so breaks up, when punished at a temperature varying from 500° to 600° Fah., as to become difficult to get a bent piece; and by referring to the composition of this iron, it will be found to contain a large measure of phosphorus, which in some degree may explain its lack of power to resist percussive force at the heats just named; nevertheless, this cheap ordinary iron is much more valuable for many practical purposes than the pure and comparatively expensive wrought iron before alluded to.

TESTS OF CORROSION.

For results shown by Figs. 59 and 60, I am indebted to Mr. Rogerson, of the Weardale Iron and Coal Company, Limited, Spennymoor, Durham, who kindly instructed their chemist to test by corrosion three pieces of iron, and one medium hard and one soft steel plate, in a water bath containing 1 per cent. of sulphuric acid, for a period of seventeen days. The specimens subjected to test were 2 inches square by ⅜ inch thick; the loss in weight by corrosion was recorded every twenty-four hours. The daily loss of the common iron is shown by the line A on the diagram, Fig. 59, the daily percentage of loss by the horizontal lines, the number of days being illustrated by the vertical lines. The common iron in seventeen days lost 79 per cent. of its total weight. Tudhoe Crown iron, one of the brands of the Weardale Iron and Coal Company's boiler plates, shows by line B a loss in the same time of 46·4 per cent. Tudhoe best-best boiler plate, shown by line C, lost in seventeen days 34·7 per cent. The medium hard Bessemer steel lost in seventeen days 13 per cent., as per line D, while the soft Bessemer metal only lost 4·8 per cent., as per line E. Attention may be called to the fact that the metals, according to the impurities of their composition, lost most in the least time. A strange freak appears to have arisen on the second day with the soft steel, as at this point it had lost considerably more weight than the hard steel, but at the end of the fourth day the hard and the soft steel had lost about equal portions. From that period, however, on to the seventeenth day the soft steel, as shown on the line E of the diagram, did not lose as much as the hard metal by 8·2 per cent., and 74·2 per cent. less than the commonest iron in the same time. The composition of these metals will be seen by referring to Table B, the respective figures being as follows:

Common iron	Figure 53
Tudhoe Crown iron........................	" 54
Tudhoe best-best iron........................	" 55
Medium hard steel........................	" 56
Soft steel	" 57
Pure iron pig........................	" 58

Diagram 60 illustrates the same metals tested a second time to check off the accuracy and figures of the first; and having the same letters of reference to character of the metal, with the addition of a very pure piece of soft iron, the corrosive action of which is illustrated by line F on the diagram, and shows a less loss by 1⅞ per cent. than the soft steel during sixteen days.

The action of corrosion, as illustrated, corroborates the oxidation of the metals, as shown on diagram 59, and further reference need not be made to it, except to state that the corrosive action was a little more intense upon the whole series. The bath was the same as previously described; all the pieces were filed up true before being tested. Specimens experimented with now shown. The malleability and purity of mild steel plates, such as are used for boiler purposes, is further illustrated by Figs. 59 and 60, and may be called a new manufacture or application of steel. The bowl was blocked out of a flat plate, 2 feet diameter and ¼ inch thick, after which it was rounded up cold and then annealed. The bowl are a duplicate of Fig. 59, but turned and polished inside and out, and afterward mounted and electro-plated inside. The base upon which the bowl is fixed is also made from a piece of ordinary Bessemer steel, and is a remarkable contrast in fineness and solidity of surface, when compared with ordinary iron plate or malleable wrought iron. Blocked cup and finished bowl now exhibited. The writer is of opinion that many articles of ornament and decoration may be made from this metal, where the leading features are symmetry and beauty of outline. The result of the experiments that have been put before you, however imperfectly, were carried out with care, and truthfully recorded, and from them it will be apparent that the users of metal must, as it were, make some natural selection to secure the highest and best results for any special purpose; and it will also be clear that no wrought iron can resist concussive force equal to mild steel, and as a much higher range of ductility and carrying power is attained, it will force the attention of constructive engineers to use it much more extensively in all cases where strength and lightness are required.

EFFECTS OF SEA WATER ON STEEL.

Should it ultimately be proved that sea water will destroy steel quicker than wrought iron, we might continue the application of wrought iron for the skin of ships; but with our present knowledge nothing should arise to prevent the whole framework of every steamer and sailing vessel being constructed of Bessemer or Martin-Siemens steel, as at least one-third of the total weight may be saved with much greater security.

In the diluted sulphuric acid bath the evidences are quite clear in favor of mild steel and the purest iron to resist corrosion, but before as much can be said as to the influence of sea or salt water, a more extended and careful series of experiments are required.

The same may be said of the selection of metals for the construction of artillery, and the writer has no doubt that by a still more careful manufacture, to keep down the carbon and injurious alloying substances common to wrought iron, the most enduring armor-plates might be manufactured by the pneumatic or Martin-Siemens process.

Probably the pure iron, with a very low tensile strength, would appear to be the best adapted to withstand the shock of a cannon ball without breaking up; but whether such is worth carrying out by the "man of peace" may be a debatable question.

STEEL FOR BRIDGES.

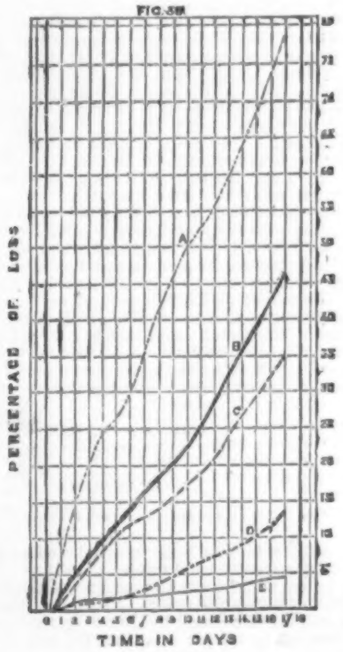
There can be no doubt that the medium hard class of steels, possessing double the strength of the best wrought iron that can be made, could, without exception, to be applied to the purpose of bridge building and a variety of other similar structures. Up to this it has hardly found a place, and has had no consideration in proportion to its excellency and intrinsic value. Thousands of tons of this metal can be got from several eminent manufacturers of Bessemer and Martin-Siemens steel, with a certainty and regularity of composition far exceeding that that can be accomplished with any class of wrought iron made by the puddling process.

WEAKENING EFFECTS OF CINDER.

The strength of a wrought iron plate is seriously reduced when pulled asunder across the fiber in proportion to the quantity of cinder it contains. This unfortunate principle does not so much apply to bar iron, as the mixed cinder is rolled into streaks or in parallel lines with the bar, only slightly disturbing the tensile strength of the iron, when it is subject to a strain in one direction; hence a combination of good pig irons may be used and manufactured into plate iron, but the good material be spoiled by having too much cinder alone left in the iron, always robbing it of its strength and endurance in one direction to resist a working load.

Cinder as mechanically mixed with wrought iron can be well seen by planing and polishing the trod of a wrought iron rail; the cinder is then shown to form disruptive lines in the direction of the length of the rail, and when put to work under a heavy rolling load, the iron breaks down latterly for want of cohesion, arising from an interposition of earthy matter. The purity and superiority of a steel rail is made clear by subjecting it to the same treatment. Two pieces of rail produced. The test and illustration of the pure iron clearly indicates a low carrying power, but it is more than probable that such a metal, if worked down into thin plates, might be used in a large measure as a substitute for copper plates in the fire-boxes of locomotives, or better still, if the same qualities could be secured by the Bessemer and Martin-Siemens process of manufacture so as to get rid of the last trace of cinder.

FIG. 59



Ordinary merchant or Staffordshire iron, or a Cleveland bar, although only possessing a very small power to resist percussive force at a color heat, yet are much better adapted for the purpose of a chain cable or a rod to suspend a steady load, and though such are comparatively impure as iron, they possess a much higher tensile strength than the purest wrought iron found.

IMPURE METALS NOT SUITABLE FOR ARTILLERY AND FIREARMS.

It is true these impure irons are not adapted for the manufacture of fowling pieces or rifles, as by quick firing a color heat may be approximately developed, the gun barrel being then liable to burst and fly in pieces, thereby jeopardizing the life of the user. At all times it will be well for both the sportsman and soldier to remember, if quick firing is desirable or demanded, that the gun or rifle barrel should not be allowed to get unduly hot. The same consideration should be given both in the selection of metal for the construction of cannon, and in some measure in the use of artillery.

PRECAUTIONS IN THE MANUFACTURE OF ARTICLES IN IRON AND STEEL.

Probably one of the best applications of the soft pure iron is to use it for stamping purposes, such as the manufacture of the details of gunlocks, where an easy flow of metal at a plastic heat is desirable, and the articles when finished will bear case-hardening without flaw or breaking up. The strong metals that will carry the highest tensile strain and possess great resisting power must be carefully treated in the manufacture, or the whole of its advantages may be turned to destruction. No violence is admissible, and the action of cold punching in such cases ought for ever to be abandoned; and according to the writer's experience, cold punching at all times is a barbarous system of rude manufacture that oftener than is suspected leads up to destruction. The color heat tests ought to be impressed upon all workmen to prevent the hammering of metals when half cold, or the heating of iron by red-hot iron for some final adjustment; where hammering is required it would be a better and wiser policy to only heat the iron with boiling water, or by applying steam against the surface for a short time. Finishing forgings or smiths' work by hammering at a black heat at all times proves highly injurious unless great care is afterwards used in annealing, and it is questionable then whether the full measure of strength of the metal in many cases is ultimately restored. The dangerous temperature can also be produced by allowing engine fly-shafts, railway carriages, axles, and such articles to become hot, and boil off the grease or tallow, or for want of lubricants attain a temperature at which they are most liable to break down. In all such practical operations the work should be stopped and the metal left to cool. In the case of steel fly-shafts, cooling by water of a hot neck has a tendency to split the shaft in the journal and produce transverse cracks, that when afterwards put to work cause it to break down disastrously.

THE TEST AT WHICH THE STRENGTH OF IRON IS AFFECTED.

The strength of the purest iron no doubt is seriously interfered with at about 600° of heat Fah., and especially its power to resist percussive force, but in what way the cohesion of the particles are disorganized at a temperature midway between a cold bar and a moderate working red heat, may not be easy to describe; but such being the fact, the greatest care should be exercised in all such ordinary practical operations. In conclusion, the writer has to express his great obligations and thanks to several iron and steel manufacturing firms, for their assistance in furnishing materials for testing, and the composition of metals under investigation—among them may be named our president, Dr. Siemens; Mr. Richards, of Bolckow, Vaughan & Co., Middlesbrough; Mr. Rogerson, of the Weardale Iron and Coal Company, Spennymoor; Mr. Ellis, of John Brown & Co., Sheffield; Messrs. Charles Cammell & Co., Sheffield; Thomas Walmsley & Sons, Bolton; and the Steel Company of Scotland, Glasgow.

The President remarked that he scarcely ever heard a more practical or better put-together paper than that which had just been read.

Votes of thanks having been awarded to the authors of the papers, the President, after a word of compliment to the authors of the papers generally, invited discussion.

M. Frémy said he had only to express the sentiment of admiration with which he had listened to the papers, more especially mentioning that of Mr. Adamson, than which nothing could have been finer.

M. Henri Tresca also complimented Mr. Adamson on his paper, and referred especially to the experiments made with the bars of iron and to the results of the elongation of the different portions of that bar. He did not know whether visitors had ever remarked at the exhibition an exhibit in the shape of an American machine—that of Bliss & Williams. It was a very well constructed one, and its purpose was for converting by one operation a sheet of tin or sheet iron into cylindrical or other form.

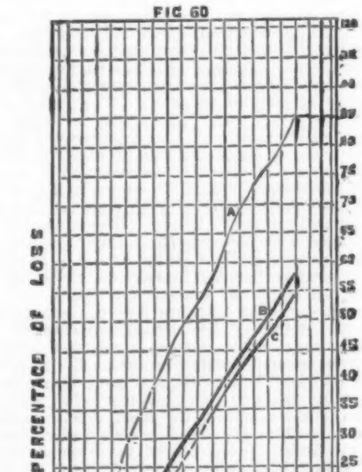
REMARKS BY DR. SIEMENS, THE PRESIDENT.

The President, in offering a few observations on the papers, said he agreed with Mr. Adamson entirely in his objections to short specimens. Mr. Adamson had explained the objection so well that it was unnecessary to go into the reason why they were objectionable. But he regretted that Mr. Adamson, when he adopted the long specimens, did not stop with the 8-inch specimens, and adopt the 10-inch specimen for his length. The 8-inch had been adopted first of all by the French Admiralty. It was adopted by the English Admiralty, and by Lloyd's, and it had found its way into very large practice. In adopting measures it was of very great importance to have unanimity. How could we compare results obtained by Mr. Adamson with results obtained according to the Admiralty standard, so long as the two differed the one from the other? Mr. Adamson's paper would, he felt sure, take the character of a standard work on the mechanical properties of steel, and he only regretted that Mr. Adamson should have thought it necessary to adopt a unit differing from that already so largely adopted. However, there could be no *a priori* objection to doing that. The specimens brought forward by Mr. Adamson were very beautiful, and he had succeeded in welding up an anchor in a very perfect manner, but he—Dr. Siemens—objected altogether to welding things which could be made entire. Why not roll them up at once? Perhaps Mr. Adamson would tell the meeting why he adhered to welding instead of making the thing entire.

EFFECTS OF MANGANESE ON THE CORROSION OF IRON AND STEEL.

With regard to corrosion of steel and iron, the experiments had been very interesting. The question was one which had occupied the attention of the English Admiralty, and the Institute had discussed it on several occasions, but the results which had been brought forward had never been satisfactory. Mr. Adamson had put forward tests which made steel come out much better than could have been hoped for from the results brought forward by the Admiralty Committee. He could not see why really pure metal, well melted, should corrode more than an impure metal, where different substances were at war one with the other.

FIG. 60



The real reason, in his opinion, why some specimens of mild steel had given such favorable results was owing to excessive manganese. Altogether, he fully maintained the view he had already expressed—that manganese was only a cloak to hide imperfections in steel; and when you wanted a high-class metal, you should have it as pure as possible, containing a little carbon to give strength, but as little of other materials as possible. Mr. Adamson had also alluded to steel higher in carbon than the mild steel now used for bridge building, and so forth. He thoroughly admitted, with Mr. Adamson, that it was absurd to put in a bridge, when you only wanted moderate extension and great strength, a metal which would bear without breaking a tensile strain below 30 tons, when you might have for the same money, and with the same ease, metal which would resist 45 or 50 tons. The Board of Trade had, after a great deal of argument and endeavor on the part of the trade to induce them to recognize steel, consented to allow steel to be used in engineering construction, but only with certain limitations—that was, the Board would only credit steel with 6¼ tons per square inch, and you might well put in a material that would resist 100 tons. You were only allowed 6¼ tons for it, and while that rule was maintained the engineer was powerless to adopt the material of the higher class. That difficulty also, however, must vanish before the force of fact, and Mr. Adamson's paper would do valuable service in furnishing facts for members to consider and act upon.

STEEL AND IRON IN THE BRITISH NAVY.

Mr. Barnaby, Chief Constructor of the British Navy, expressed the great pleasure it had given him to listen to Mr. Adamson's paper and to the other papers that had been read that morning. He was glad that Dr. Siemens had called attention to the question of the length of the sample by which the elongation was tested. It had fallen to his own lot to decide for the English Admiralty what the length should be, and he was careful to make it the same as that which the French Admiralty had adopted. The test used in England was precisely the same as was being used in France. It was a matter of very great satisfaction to him that engineers employed in the construction of ships for the Government of England received the very kindest consideration from the gentlemen who occupied a corresponding position in the French navy; and he trusted that Englishmen were not wanting on their part in reciprocating that courtesy. It might be interesting to the meeting to know how we stood in the matter of our mild steel in shipbuilding. Some ten or twelve years ago he made a great many experiments for Mr. Reed, former Chief Constructor, at Chatham, upon mild steel made by the Bessemer process by the Bolton Steel Company. It was a very excellent material, but did not commend itself to the Admiralty to a large extent, and for the reason which Mr. Adamson had given in his paper. The steel which the Admiralty were using now was a very different material. It was quite true that it needed some care in its management, but the amount of care which it needed was not nearly so great as some engineers supposed. No doubt the steel when pinched suffered from that operation unless the holes were afterwards countersunk or reamed out in some manner; but the loss was very small—so small that the Admiralty were building a number of ships, the plates on the bottoms of which were punched, and they did nothing with the holes, the loss from the operation being insignificant. These mild steel plates were not annealed after punching, and for this reason. When they used these steel plates in the dockyards they annealed them, but when the work was done by private builders, they preferred not to anneal them, because they considered that the amount of loss by punching was not sufficient to warrant them in running the risk of having the plates badly annealed. They found also that as the plates became thicker they lost more than when thin by the operation of punching. They had discovered likewise that the plates, when they were riveted up, suffered more by that operation than by the first operation of punching. It would be found that in that case there was a very considerable loss of strength. The Admiralty had had that peculiarity in steel under their careful consideration, with the difficulty of drilling plates. In making boilers, as Mr. Adamson had suggested, they should always drill, but in building a ship it was not so easy to drill, and it was necessary to do a large amount of work by punching.

There was another difficulty in regard to the use of steel which had been referred to, namely, that perhaps in salt water there was more oxidation than in the case of iron; but for his own part he did not believe that that was true. The Admiralty had made experiments extending over four years, and though at first the pieces of steel suffered more loss than the pieces of iron, the difference in loss did not continue, and in the end the steel appeared to be just as good, if not better, than the iron. In the royal dockyards we were coming to this position, that the Admiralty, instead of using iron of the quality they had been obliged to use previously, proposed for the future to use only steel, and he believed they would find that they would not only gain in strength, but in point of money also. The precaution which they took in regard to plates was this: No single plate was used by the Admiralty unless a shearing of it from the end had been tested, first by heating, and then by cold water, and bending nearly double; and Lloyd's surveyors in England had determined that the brand which should be insisted on for the plates used for ships built under their inspection should signify that each plate which had been branded had been tested by a piece taken from it.

THE TELEPHONE AND TERRESTRIAL MAGNETISM.

M. DE PARVILLE has just suggested the use of the telephone for determining the position of the magnetic meridian—that is to say, the true direction of the magnetic needle. It is sufficient to take a Bell telephone, of which the magnetic core consists of a bar of iron a meter long, suspended with an angle of inclination similar to that given by an inclination needle. Under the influence of terrestrial magnetism this bar becomes magnetic, and the telephone can transmit the sounds produced by any vibrator placed near its mouth. These sounds are naturally stronger as the magnetism of the bar increases, and, if the telephone be turned round the horizon, keeping the bar at the same inclination, the sounds transmitted in the receiving telephone are at their maximum when the axis of the bar is in the plane of the magnetic meridian, and at their minimum when at right angles to this direction. Thus, by the direction which this axis occupies when the sounds are inaudible, can be recognized the exact direction of the magnetic poles. By this system the influence of the masses of iron which so sensibly affect the magnetic needle on iron ships would be almost *nil*. An orientation more exact than that of the compass can be obtained. The same process could be applied to measuring the variations of the earth's magnetism.

METALLIC tiles are being introduced very extensively in several countries on the continent of Europe. They are lighter than common tiles, and do not decay so rapidly as might be imagined. Corrugated plate and charcoal pig-iron are both used in the manufacture of this new kind of roofing. We suggest that our European brethren would do still better to make use of tin roofs, all the joints soldered.

BELGIUM AT THE PARIS EXHIBITION.

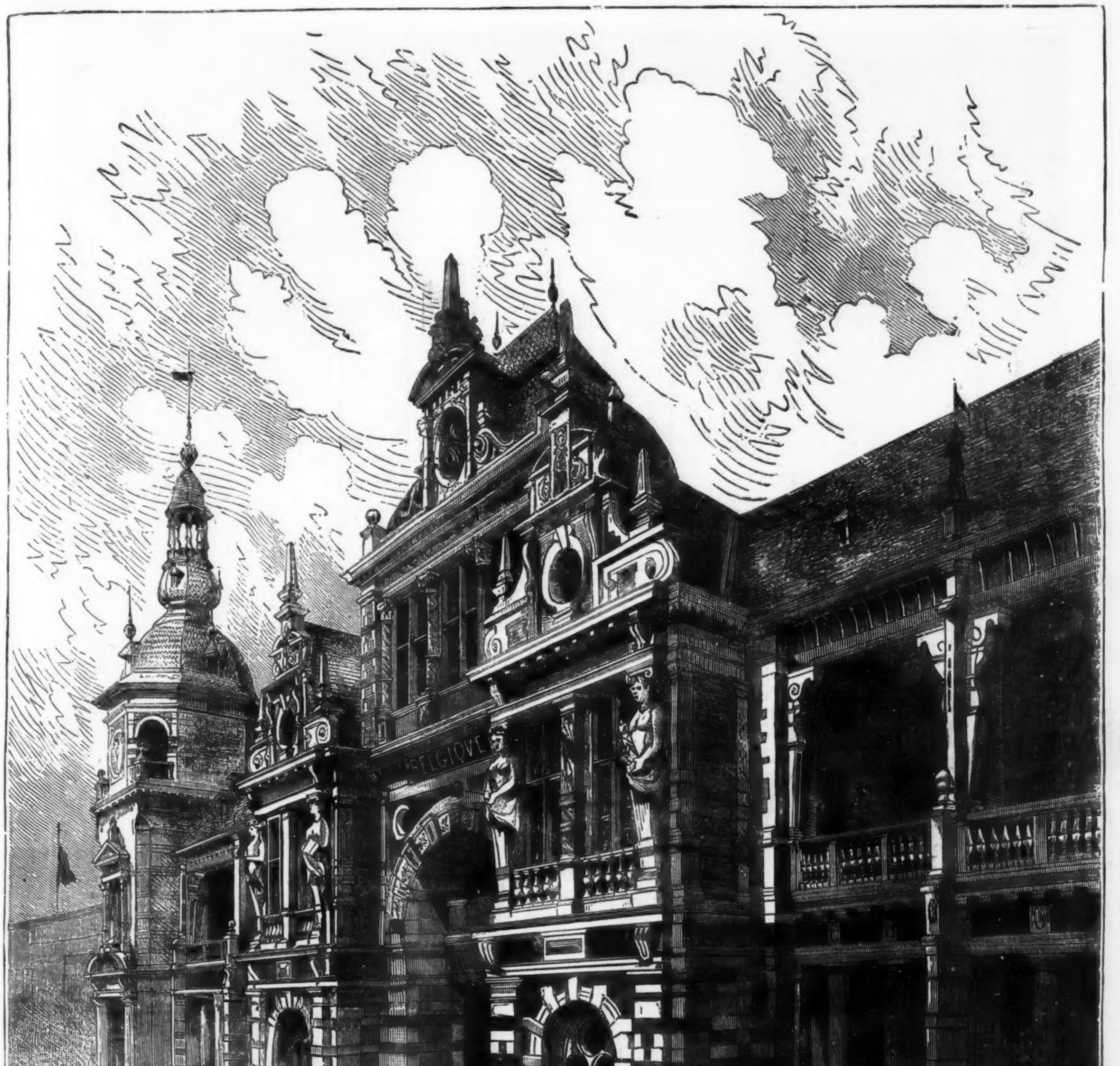
THE efforts of the Royal Belgian Commission to insure a creditable representation at Paris of that small but highly enterprising kingdom have been crowned with success. The Façade of the Belgian Section, of which we give an engraving, is one of the most notable structures within the domain of the Exhibition. It was constructed of materials, and by men from Belgium, by master workmen, marble workers, sculptors, and decorators, under the direction of M. Jaulet, an architect of celebrity. It introduces the style of some of the castles and old monuments of Belgium without reproducing the exterior of any particular edifice. Its columns of precious marble, its gray colored stone work, elaborately cut, its statues and rilievi, sculptured with the utmost perfection, impart a character of magnificence, and stamp the whole with the seal of monumental grandeur.

The interior of the Belgian Section is full of surprising exhibits: Coal working and other apparatus, that compete with the best of the English products, steam engines, cylinders, tubes, firearms, cutlery, zinc and lead manufactures; the finest woven lawns of Brussels and the richest thread laces of Tournay and Malines; damasks, cloths and tapestry of Verviers; superior paper; the finest glass ware and porcelain objects; the finest cabinet ware from Spa, etc.

Notwithstanding the smallness of the territory of Belgium, she occupies an important place in the general commerce of the world, which is due to the steady and laborious industry of her people.

AN IMPROVED WHALING GUN.

AN invention which promises to be of great importance to the whaling interest in the taking of oil, has recently been brought out by H. W. Mason, of New Bedford. The invention consists in a harpoon, with which whales can be taken with perfect certainty, from a distance of ten or twelve fathoms, making it easy to secure whales which it is next to impossible to get near enough to strike with a harpoon



BELGIUM AT THE PARIS EXHIBITION.

thrown by hand. The harpoon is of novel construction, and is shot from a gun weighing only twenty-four pounds, which is handled as easily as a forest gun. Mr. Mason overcomes the difficulty of firing with accuracy a harpoon with line attached, by coiling the line on the gun in such a manner that the coils follow the line of shot, and thus serve to guide the harpoon straight to the mark. This invention has passed the experimental stage, and is a practical success. Its general adoption by whalers can only be a question of time, as already some of the most experienced whalemen give it their unqualified approval.—*Boston Jour. Com.*

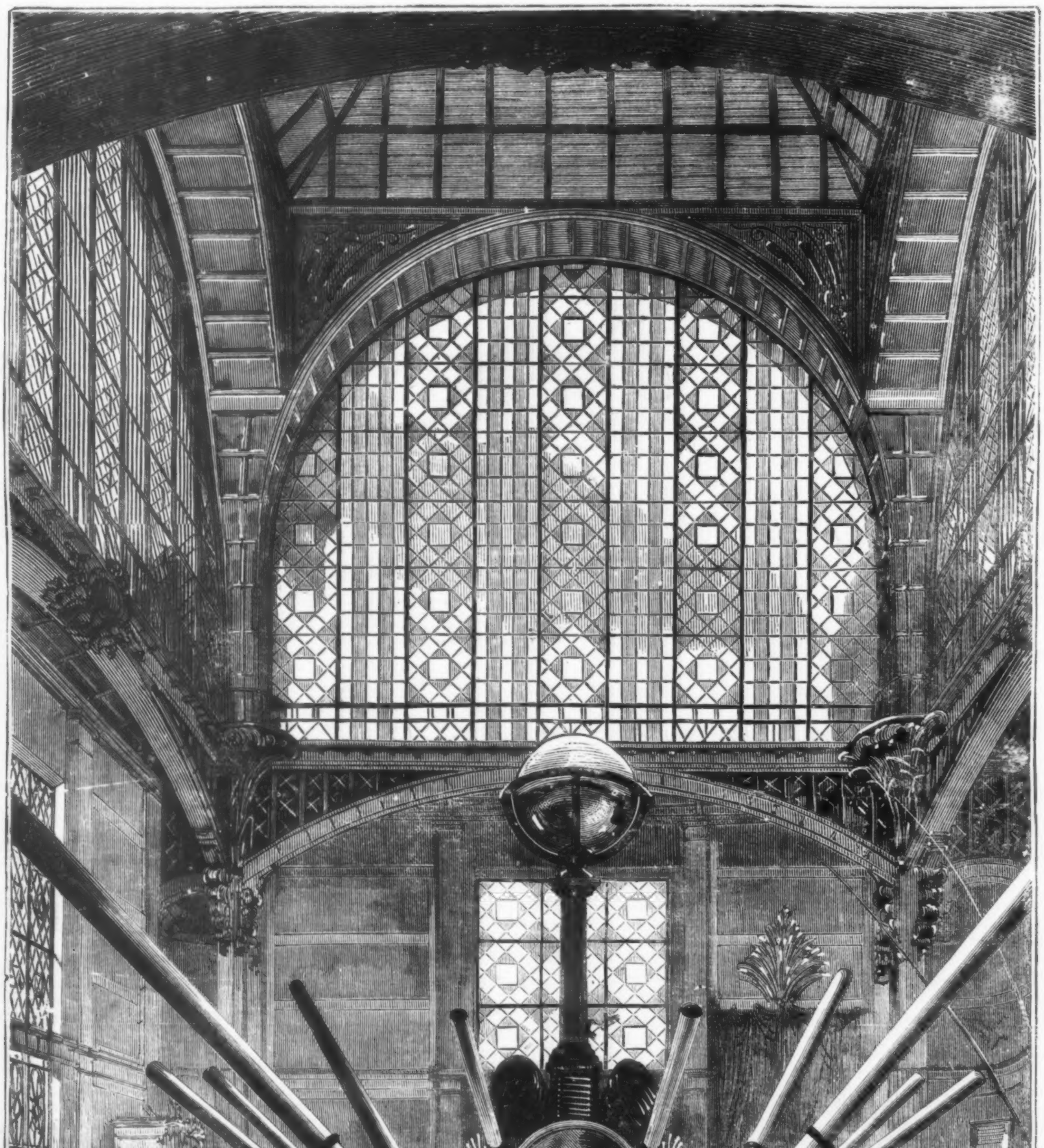
THE PAVILION OF COPPER.

ONE of the most remarkable exhibits at the Paris Exhibition is that of M. Laveissière, the celebrated manufacturer of copper. His specimens occupy a special building in the Campo de Marte, and their wonderful peculiarities attract crowds of people. Our engraving shows an interior view of the building, which is justly styled the Pavilion of Copper.

The large central sphere, made to represent the terrestrial globe, is composed of two immense pieces or shells of copper, designed for use in the manufacture of sugar.

The large and small projecting tubes, the rings, wheels, the different pieces of copper and wrought iron here brought together and so artistically arranged, are practical examples of sundry parts actually required in the construction of condensers, for marine engines, locomotives and other mechanisms of great industries in which the use of copper is necessary.

AUSTRALIANS exhibit rare and delicious fruits at the Paris Exhibition, and claim to be able to regularly supply the mother country with these southern delicacies, notwithstanding the great distance.



THE PAVILION OF COPPER.

(Continued from SUPPLEMENT No. 149, page 2371.)

THE PARIS EXHIBITION PRIZES.

BRONZE MEDALS.

Tilden, William & Stokes, New York city, varnishes.
Tilt, B. B. & Son, Paterson, N. J., Jacquard power silk loom.
Trainer, David & Sons, Linwood, Pa., Omega tickings.
Trowing, collaborator, Mason & Hamlin.
Uhrig, Joseph, Brewing Company, St. Louis, Mo., lager beer.
Underwood Belting Company, Tolland, Conn. (two bronze medals), main belts, for use of Commission.
Urbana Wine Company, Hammondsport, N. Y., sparkling wines.
Valentine, M. S., Richmond, Va., meat juices.
Van Nostrand, D., New York city, publications.
Vandermoud (collaborator).
Victor Sewing Machine Company, Middletown, Conn., drill chucks and micrometer calipers.
Walz, Alphonse, New Orleans, La., bitters.
Wardwell Manufacturing Company, St. Louis, Mo., two spool lockstitch sewing machines.
Warner Brothers, New York city, patent corsets.
Warner, William R. & Co., Philadelphia, sugar coated pills and pharmaceutical products.
Weston Dynamo-Electric Machine Company, Newark, N. J., process of electroplating, electrotyping, etc.
Wheeler & Wilson Manufacturing Company, New York city, cabinet work, embroidery, etc. (three bronze medals).
Whitcomb, G. H. & Co., Worcester, Mass., envelopes made by machinery.
Whiton, D. E., West Stafford, Conn, large chucks, gear cutters, centering machines.
Wiley, John & Sons, New York city, scientific text books, thirty five volumes.
Wilson, George, Brooklyn, N. Y., surgical, invalid and recumbent easy chair.
Wilson, Walter J. & Co., Philadelphia, crackers, cakes and biscuits.
Withington & Cooley Manufacturing Company, Jackson, Mich., garden and farming tools.
Wolf Bros. & Keech, Centreville, Mich., essential oils of peppermint, spearmint, wormwood.
Wrights, Joshua & Sons, Philadelphia, Pa., minced meats in cans.
Wyeth, John & Brother, Philadelphia, pharmaceutical preparations.
Zell, T. Elwood, Davis & Co., Philadelphia, general encyclopædia, suitable for reference in schools.

HONORABLE MENTION.

Adams, Blackmer & Lyon Publishing Company, Chicago, Ill., school text books.
Adams & Shaler, New York city, extract of bark.
Allen, R. H., & Co., New York city, warehouse trucks, furnished for use of Commission.
Andres, S. R., Philadelphia, Pa., beans, prepared as food; bean flour.
Asher & Adams, New York city, map of the United States.
Aultman, C. & Co., Canton, Ohio, agricultural machines.
Baker, J. R., Manufacturing Company, New York city, anti-friction, non-corrosive metals.
Barney & Berry, Springfield, Mass., skates.
Barry, Peter, New York city, panel painting for carriages.
Baugh & Sons, Philadelphia, Pa., chemical fertilizers and raw bone material.
Beal, J. H., New York city, photograph of New York city.
Beaudet, Homer J., Greenpoint, L. I., swing convertible cradle and combined rocking chair cradle.
Blackmar & Allerton, Newark, N. Y., clover seed, white and red winter wheat.
Bliss & Dean, Attleboro, Mass., jewelry, lockets, etc.
Boericke & Tafel, New York city, homeopathic medical books.
Boyd & Chase, New York city, oilstone for sharpening artists' and mechanics' tools.
Bracher, T. W., New York city, ventilators, air filters and moisteners, etc.
Bradley, G. W., Hamden, Conn., corn.
Brewers' Journal, New York city, *The German and American Brewers' Journal.*
Brewster & Knowlton, Boston, Mass., cabinet of minerals.
Brush, Virginia, New York city, ornamental screen, painted in water colors.
Bulkley, Dunton & Co., New York city, blotting paper.
Butler, J. H. & Co., Philadelphia, Pa., text books for elementary instruction, 29 vols.
Calvert Sugar Refining Company, Baltimore, Md., scum used for manufacture of fertilizers.
Chatfield & Woods, Cincinnati, Ohio, paper bags, made by machinery.
Claxton, Remsen & Haffelfinger, Philadelphia, Pa., scientific text books.
Cleveland Paper Box Machine Company, New York city, paper boxes.
Compton, D. A., Hawley, Pa., corn in the ear.
Conger & Kelly, New Orleans, La., sugar.
Cresson, George V., Philadelphia, Pa., shaftings, pulleys, couplings, etc.
Davis, J. W., Washington, D. C., the Davis elevating telescopic signal.
Davis, Robert S. & Co., Boston, Mass., Greenleaf's mathematical series.
Day, Austin G., New York city, kerite insulated telegraph wire.
Diamond Mills Paper Company, Millburn, N. J., medicated closet paper.
Edson, Marmont B., New York city, automatic recording and alarm gauge.
Eldredge & Brother, Philadelphia, Pa., text books for schools of different grades.
Ervien, Charles W., Philadelphia, Pa., horizontal and vertical non-condensing steam engine, sent for use of Commission.
Exton, Adam, & Co., Trenton, N. J., unfermented crackers and biscuits.
Faller, George J., Philadelphia, Pa., sewing machine oil.
Farrington, H. J., New York city, bedsteads.
Fisher, S. E. & Co., North Attleboro, Mass., gilt jewelry.
Fletcher Manufacturing Co., Providence, R. I., shoe strings, kerosene, lamp and stove wicks.
Foreman, John A., Muscogee, Indian Territory, field and sugar corn, corn meal, hominy and grits.
Frazer Lubricator Co., New York city, axle grease.
Gaff, Rush & Thomas, Columbus, Ind., hominy, grits, pearl meal, corn flour, feed meal, corn meal, yellow corn.
Gaines, S. M., Cambridge, Mass., Gaines' Chemical Alphabet.
Gay, Edward J. & Co., New Orleans, La., sugar, molasses and sirup.
Gold, T. S., West Cornwall, Conn., buckwheat.
Goulds' Sons, M., New York city, stair rods, dog collars, stair plates.
Green Serpentine Marble Company, Wilmington, Del., Maryland serpentine, or "verde antique" marble.
Gurney, J., New York city, colored and enameled photographs.
Haller, Ella, Philadelphia, Pa., hydro-platinum, self-lighting lamp.
Harrington, Edwin & Son, Philadelphia, screw hoisting machines for exhibition and for use of Commission.
Hartshorn, Stewart, New York city (manufactory East Newark, N. J.), window shade rollers.
Hauthaway, C. L. & Sons, Boston, Mass., blacking and dressing for leather.
Hayes, George, New York city, model of windows, showing perforated metallic window blinds and ventilating skylights.
Hayes, M., Dover, Del., cereals.
Henkle, W. D., Salem, Ohio, *Ohio Journal of Education.*
Higginson, T. W., Newport, R. I., "School History of the United States."
Hollingsworth, Z. T., East Walpole, Mass., rope-wrapping, sand, emery and tag papers.
Jaslin, Gilman, Boston, Mass., one celestial and three terrestrial globes.
Jenkins, W. H. & Son, New York city, doors and sashes.
Johnston, E. S., Philadelphia, Pa., window shade rollers.
Keith, B. & Co., New York city, oil of erigeron.
Kemble, Miss Mary W., New York city, lace painting.
Knapp Dovetailing Machine Company, Northampton, Mass., machine for dovetailing.
Knias, W. B., Philadelphia, books for the blind.
Kroeber, F., New York city, fine walnut case clocks.
Lassales, Charles & Co., New York city files of *Courrier des Etats Unis.*
Lee & Shepard, Boston, Mass., text books.
Leonard & Ellis, New York city, lubricating oils.
Liebrandt & McDowell Stove Company, Philadelphia, Pa., heating stoves, cooking stoves, ranges.
Lighthouse, J. C., Rochester, Wy. T., horse collars.
Lippincott, William H., Philadelphia, banner or shield, exhibiting a variety of native American woods.
Lockwood, Howard, New York city, books.
Lothrop, D. & Co., Boston, Mass., books and magazines.
McCurdy, Lime, Conn., granite.
McIlroy, T., New York city, surgical operating tables.
McLaughlin, Louise, Cincinnati, Ohio, painted porcelain and pottery.
Mellor & Rittenhouse, Philadelphia, extract of licorice root.
Mersereau, W. T. & J., Newark, N. J., stair rods.
Meyers, A. G., New York city, water closets, wash basins and urinals.
Moline Wagon Company, Moline, Ill., one farm wagon.
Mower, E., Roxbury Station, Conn., granite.
Muhr's, H., Sons, Philadelphia, gold rings and lockets.
Nathan & Dreyfus, New York City, injectors and ejectors (steam pumps).
National Car Spring Company, New York city, railway car springs.
Norton, C. B., New York city, book, "Treasures of Art, Industry and Manufactures at the International Exhibition, 1876."
Olmstead, F. L., New York city, landscape drawings.
Oscillating Pump Company, New York city, force and bilge pumps.
Packer, Charles W., Philadelphia, paper box manufacturers' machines.
Page, E. W., New York city, boat oars.
Page (W. H.) Wood Type Company, Norwich, Conn., specimens of wood printing type and printing from the same.
Pennypacker & Brother, Philadelphia, doors, sash, blinds and shutters.
Peters' Combination Lock Company, Waterbury, Conn., combination locks.
Redpath, F. W., Stony Creek, Conn., granite for building and monumental purposes.
Ricketts, J. H., Newburg, N. Y., wines.
Roberts & Co., New Orleans, La., cypress doors, etc.
Rogers, C. B., Philadelphia, Pa., diamond wheat.
Schaffer, William, New York city, square pianoforte.
Schuttler, Peter, Chicago, Ill., farm, freight and plantation wagons.
Sheble & Fisher, Philadelphia, forks, drags, cast steel rakes, etc.
Sheldon & Co., New York city, text books.
Shields, J., Brooklyn, Mass., fishing tackle, as silk lines and artificial flies.
Short, H. B., Flemington, N. C., cypress shingles.
Sibole, J. L. & Co., Philadelphia, Pa., illustrated books.
Smith's Homeopathic Pharmacy, New York city, homeopathic preparations.
Snell Manufacturing Company, Fiskdale, Mass., augers, car bits, auger bits.
Steiger, E., New York city, Encyclopædia of Education.
Stewart, S. N., Paris, France, umbrella and camp chairs and stools.
Stiles, E. W. & Co., marine and stationary inkstands.
Taylor Manufacturing Company, Westminster, Md., agricultural implements.
Tilden & Co., New York city, crude materials of American medicinal plants.
Tower, John J., New York city, iron planes, wrenches, padlocks, etc.
Trump Brothers, Wilmington, Del., foot power scroll saws.
Tuchfarber, Frank, & Co., Cincinnati, Ohio, enameled and porcelain finished.
Tunyoap Manufacturing Company, Boston, Mass., tunyoap.
Underwood, John, Hoboken, N. J., chemical safety paper for safety checks.
Union Paper Manufacturing Company, Holyoke, Mass., writing paper.
United States Regulation Firearms Company, New York city, Springfield muskets.
United States Department of Agriculture, Washington, D. C.
University Publishing Company, New York city, text books.
Waterbury Button Company, Waterbury, Conn., metallic buttons, army, navy and other special designs.
Wiley & Ru[illegible] Manufacturing Company, Greenfield, Mass., screw plates, [illegible] cutting machines.
Winchell, S. R., Chicago, Ill., *National Educational Weekly,* 1877, one volume.
Woglom, W. H., New York city, paper clips and files.
Young & Bennett, North Attleboro, Mass., gilt watch and neck chains.
Zallee, John C., St. Louis, Mo., suit of men's wearing apparel.

[Continued from SUPPLEMENT No. 149, page 2372.]

AN IMPRESSIONIST AT THE PARIS EXHIBITION.

THE Minister of Public Instruction makes first a display of the results of French scientific explorations. The French have been more active than one would think, now that their colonial period is so nearly over. The educational progress of the citizen is next traced from the bottom to the top.

If he be of humble circumstances, it begins with the *crèche.* It is increasingly difficult in an old civilization for the labor of one person to be the maintenance of two. Both parents work. The infant is left at the *crèche* in the morning, to toddle in a central ring with his compatriots, as if a board of superannuated stock brokers; or to lie in an extremely neat crib, with an inscription showing that it was founded by Madame la Marquise Montjoie St. Denis, and to be called for at night. At the age of two and a half it is eligible for the *asile,* attached to the primary schools. He is amused here all day with kindergarten exercises, and called for in the same way. I have seen him, by some legerdemain of a new process, spelling three-syllable words at sight. The ambition of decorations begins to be inspired in him already. He wears, for this and that, on the breast of his small blouse, a red ribbon with a sparkling cross that leaves little for the Legion of Honor to do. I find very interesting the provision which is made to usher him into life as a self-sustaining and contented member of society after his education. There are schools of apprenticeship and societies of patronage to aid to places and to keep an oversight of the young mechanic who has learned his trade in them. Large industrial establishments, such as those of the silk weavers at Lyons and the great printing house of Chaix, have technical schools for the training of hands for their work. It is not a system peculiar to France. To take only one instance, Owtchinnikow, the Moscow jeweler, whose napkins in filigree of silver pleased us so much at Philadelphia, maintains for one hundred pupils a school of primary instruction, design, sculpture, singing, and gymnastics. There is a close connection between these European states. What one has the others are not long in adopting.

Then there are the systems of *prévoyance,* economy, and provision for old age, upon which an interesting congress has just been held here. It is the practice in forty establishments of Paris to set aside weekly a sum, added to the regular wages of the laborer, or reserved from them, for the *caisse de retraite,* a retiring pension. The foreign workman has not the horizon of the American. More is done, therefore, to make his condition tolerable. The chance with us that it is to be something only quite temporary is taken as reason enough for letting it be as it happens. It is not the boy alone; the girl also is an object of forethought. Here are beautiful sewing and embroidery from a primary school of Lucca, and here a programme of similar works and domestic economy from the primary system of the Canton de Vaud.

For upper female instruction an immense portfolio of lead pencil copies after lithographs, from the Royal College of Verona, need cause no discouragement at Wellesley or Vassar. On the other hand, the portfolio of life studies in oil from the female college of Cracow, Austrian Poland, is calculated to arouse the warmest enthusiasm. A Portuguese pedagogue has had the good idea of affixing the photographs of his scholars to their exercises, so that we can see the precise snubby features and shaven heads of the calm young intellectual victors whose superior arithmetic is posed for our inspection. It is but a glance we can take here and there. A fly-leaf blown back discloses the composition of Léveadie Duval, aged fourteen: "*Mon futur métier* [my future profession in life]. What shall it be? *Certes,* you ask a formidable question. I have thought— But in fine I think it would be the best of all to engage in the tuition of the young, to follow [one suspects a sly flattery here] in the footsteps of my devoted instructresses." It is quaint, this, in the midst of the 2,300,000 square feet of space roofed over. It gives one a sense of the way in which every minute part of it is quivering with life.

Japan has the most charming school houses, though I know well they would never do to imitate; Russia, a museum of pedagogy, the most complete collection of appliances. The history of itself which the University of Saragossa has caused to be written expressly for the Exhibition does not at all compare with the elegant Harvard book, which is here also. Models of every kind, planispheres, maps in high relief, abound with a profusion which is possible in quarters where the technical skill to construct them is not rare. Seeing them, you feel that you did not have a fair chance in your time. There is no telling what you might have arrived at with all the motions and shapes of things so clearly presented, instead of having to revolve them dimly in your head. It is possible that we can teach the French something in the ordering of the discipline of primary schools. They have a respect for us educationally, I know. On the other hand, we can learn immensely of them in the way of making the superior instruction interesting by utilizing in it real scholarship and current research.

To pursue the liberal arts: if the English astronomical and photographic apparatus be the best, France and Switzerland divide the honors of the array of smaller instruments of precision, and Russia and Austria have the most satisfactory photographs, of a straightforward kind, without too much retrenching, though this is a department in which scarcely any participant is weak. We excel in false teeth. It is strange, is it not, that prominence in this particular branch should fall to us? I wonder, in passing the intensely respectable cases of red and white, and gold plate and ominous steel drills, if it be connected with our fondness for sweet things, which the Old World does not share.

Our bookbinding, it is pleasant to find—one does not inquire the prices too sedulously—is less over-florid in the cheaper sorts, and as simply elegant in the better as that of any competitors. There are some peculiar felicities of tree calf, and plain calf in colors, and the *reliure d'amateur*—of red morocco back and corners and paper sides, after the French—that leave nothing to desire. I wish we could add to the repertory, for cheap, strong bindings, the plain gray linen of the French scholar libraries. It is refreshing enough almost to make one read through an algebra for pleasure. For the interiors of books, it is only in the corner of the Paris publishers that you find the exquisite small classics, the Paul and Virginia, the poesies of Béranger and De Musset, on vellum-like paper with red lettering, and with small etchings between the leaves. There, too, you may bend for half a

day over the Bible of Bida, with its tender sentiment and faithful portaiture of the unchanging life of the East, and cast off forever allegiance to Doré's.

The furniture of England, which she presents, for the inspection of different effects, in complete apartments, rather more than any other, is of the kind which has most taken the fancy of our expositors of household art at home, and has been a good deal shown to us. It is open to the general remark of being too slight, and wanting in dignity, compared to that about it. It is "niggled," in fact, and you are surprised at the English. They have a character for being steady-going. It is allied to the ephemeral things of the Chinese. The vogue of the Gothic style of solid oak and bolted hinges, like a camp chest of Harold Hardrada, is quite over. A liberal deck-load would crush the tables; and then everything must be cut up into interminable niches, bracketed shelves, imitation arcades, and small railings, for the accommodation in each of an article of bric-à-brac. One sees in the solid, carved cabinets of the Spaniards, Italians, Hungarians, the habit of more simple and complete effects, the taste for a stately instead of a purely comfortable luxury. The goods are left more untroubled in the piece. The ornamentation is always some variety of Renaissance scrolls and columns. If there is not real tapestry for the walls and upholstery, its place is taken by a printed tapestry, which is becoming an important industry. The English attempts evince a warm personal interest, however, while the others seem more the easy doings of formal decorators.

There is an apartment got up by the painter Whistler—in what tones, think you? Gold, buff, ocher, but mainly tones of mustard yellow. It is not glaring, either, but harmonized with a very superior talent—art. There is a high-wainscoted Queen Anne room, with a bust of Pope, the peculiar poet of the period, over the mantel, and views from the Rape of the Lock on the walls. It is surpassed in the direction I have indicated by a quite similar Belgian apartment. Against the Queen Anne house, with wainscots in wood-stained claret color, hangings in softened sulphur yellow, and flowered muslin curtains drawn on rods across the long, low windows, I cannot invent a word of fault-finding. The vastest and most Sybaritic easy-chair is Russian. A Hungarian maker bends wood, without regard to the size of the stick, into extraordinary curves for light furniture. An example of almost incredible luxury is a French bed-chamber, in which the gilded couch, with mattresses of pink, and coverlids and a light canopy of pearl satin, all richly embroidered with flowers, lies under another lofty canopy of velvet, depending triangularly from the center of the apartment like the drapery of a royal throne. To keep in countenance this principal piece, a few of the objects are a golden figure on a low column, a lion skin, a silver table, and a lemon tree growing in a tub of Mexican onyx.

In ceramics, the French potters have the air of pursuing a steady course without rivals and sudden spasms of interest. They have long been accustomed to supplying a demand which required the graceful as a matter of course. Most of their wares are comfortably for use. You are not required to strike an attitude before the charming plates with the horn-of-plenty patterns, the blue and dull red flowers traced over them, because there are more in the shop-windows. The designs derived so long ago from Persian fabrics, and domesticated at Rouen and Nevers, persist. Newer establishments like Gien and Quimper seem almost to excel the old by a greater liveliness of fancy in the same general style, though none are remarkably new. There are from Quimper violins and even a violoncello in *faïence*, the making of which was represented not long since as something fabulous. The bold Limoges faïence of the Havilands, painted in thick, creamy pastes, of itself is a sharply-distinguished branch. It is satisfactory to find that we are sent the very best examples of it for our Broadway shop-windows.

I have a prejudice, which I am almost afraid to state, against views of persons and scenery on porcelain. What is the most agreeable is a decoration that takes hold with a real grip. You would like it if the different colored plates went through and through. An excessively finished elegance, too, is capable of exciting a sort of malice. For this reason I can walk away from Sèvres and its imitators and Dresden and its imitators everywhere, and enjoy myself with probably quite a shameful indifference among the majolicas, the stonewares, and the earthenwares a long way down. A collection has been made of the potteries actually in use among the Italian peasants. Nothing is more *naïve* than the rude ornamentation. It is almost the only place where there is a surprise in the forms. The corresponding utensils of Spain and Portugal are akin to this. When you go into the departments of Tunis and Morocco you find that it is an ancient Arabian influence still prevailing in them both. It is an influence that has been improved upon. The derivative shapes are not so extravagant as the original, and the decoration never stops at smears and dots of vermilion paint alone.

The Japanese influence elsewhere seems to have been made over for its own good in somewhat the same way. It is used in the silver work of Christofle and Tiffany, the crystal of Baccarat, the royal Worcester porcelain—there are exquisite specimens of the latter resembling carvings in ivory—with a certain temperance which it does not always preserve at home. With its normal profusion wholly turned on, the Orient is almost too overwhelming.

A Swiss ware, of red and green figures on cream and black grounds, made brilliant by a tin enamel, is an original spot, like the English Doulton. For the simple *potiches* and the rest of the usual patterns in blue and white, or with the crimson flowers of old Delft added, there is nothing, even from Delft—very meagerly represented and eclipsed by Maestricht—so nice as those from Louvières, of Belgium. Happy country that can present in every line, if not the best, something so very near to it!

The lovely porcelain stoves, of which every section has some examples to present! It is only because I am not sure enough about their working in winter that I do not enter upon an instant propaganda of porcelain stoves. It is the point in our decorative reconstruction that has been fatally neglected. Will there not yet arise some prophet of wrath—not to be appeased by the sight of nickel-plated grates—against the cast-iron stove, with its inane attempts at ornament, who will go on to show that the most conspicuous piece of furniture in the room for eight months in the year can be not only improved to the point of toleration, but can be made an extremely beautiful object?

For textile fabrics, in the spinning of cottons the English excel, and in the heavier weaving, but it is only the French for light tissues like those of St. Quentin. These are exposed here unbleached. The bleaching is done by the middle-men, according to their trade. It appears that there is a nicety in this matter. Each department has a preference of its own as to the more or less bluing and the surface it requires on its cottons. Our own familiar-looking sheetings and prints, the Wamsuttas and Washington Mills, and I may add our silks as well, are spoken of with high favor by connoisseurs for certain honest and solid qualities—it is not what we are allowed usually to pride ourselves upon. In textile fabrics it is the highest and the lowest that have an interest for the non-professional spectator. A tameness runs through the provision for the middle class in this respect as in so many others. We pause before the gorgeous tapestries and carpets, the shawls of the Compagnie des Indes, the cases of Lyons velvets, the faint amber-hued chamber of laces; and then the bright kerchiefs of Southern field hands, the patterns for the women of Frisia, the stuffs from Manchester and Glasgow for South Africa, the *rouennerie* for Algiers. In the last especially there are attractive things enough to make a little museum. There is then a whole order of pleasing coarse stuffs, perhaps of Spanish origin, extending through Southern Europe and to the South American republics. The horse-cloth of the Biscayan muleteers, in bright bars profusely bordered with ball tassels, is a type.

Whoever has seen more international expositions than one will appreciate the facilities of the nation which is at home and the difficulties of the others in putting their goods in evidence, and will distrust a little the local assumptions of leading the world in this or that with flippant ease. The catalogue of this exhibition alone comprises five volumes of encyclopædia size, and the United States, for instance, occupies but a few pages of one of them. Follow for two days—it can hardly be done in less, glancing with moderate haste to the right and the left—the two vast humming parades of machinery, local and foreign; and then there remain annexes that seem to dwarf them both. Here are ribbon saws that enable small blocks, cut into unmeaning sinuosities, to be offered at a franc apiece, as they were at Philadelphia. Here are tongue-and-groove machines; the Marinoni press, which turns off twenty-five thousand copies of a newspaper an hour, folded for delivery; brick and tile machines; stills; pumps; a sort of steam Sam Weller that takes boots on one arm and polishes them with the other; a magnificent compact locomotive for the steep gradients around Lille; one for steeper gradients still—the railway that climbs the Righi. Spain sends a ninety horse power horizontal engine, claiming to be the most economical of fuel known to the present time; Palermo, an enormous derrick; Milan, jointed ladders to shoot up to a dizzy height for burning buildings; Moscow, a great array of agricultural machinery.

I do not maintain that these tongue-and-groove machines; this winder, clucking sedately as it lifts and drops its multifarious cut-offs; this beetler, moving by a line of eccentrics, like a Brobdingnagian steel caterpillar; this screw-cutter, which rests and deliberates in its various parts in turn to deliver perfected from the hopper the material it has taken in formless at the other end, are the ultimate perfection of their kind. Like some millions of my fellow-travelers who give too little attention to the wonders of the machine shops of their native towns, and would hardly know of them except for such occasions as this, I am capable of being astonished by quite an inferior tongue-and-groove machine. The point is that they exist. I should not wish to say, without at least the opportunities of a special juryman, which nation leads the world in machinery with a nonchalant superiority.

Still there is no telling how much of all this has been taken from the extraordinary American mechanical movement for the last forty years. The sewing machines everywhere are frankly American; the agricultural machines only thinly disguised imitations. Inscriptions like the J. W. Lamb *machines à tricoter* have a familiar American sound. Three of the most splendid engines in the Exhibition are on the Corliss principle, of variable and reversible cut-offs—one built at Rouen, one at St. Ouen, another in Belgium. There are English names among the thickest of the French makers. I should not wonder if it could be shown that the real inventive germ is Anglo-Saxon, and the mission of the French in this, as in other matters in which Guizot claimed it for them, is to centralize and give the idea its most perfect form.

It is in the groups of products and alimentation that South America and the colonies rise to prominence—the countries of raw materials *par excellence*. Hardly a European state is so poor that it has not a section of the Indies or a tropical island. The programme of the gourmand is no doubt to wander continuously in these comfortable galleries of aliments, to obtain permits for the pavilion of *degustation* and the Swiss cave of cheeses, and then to seek samples of as much as possible of the rest in the polyglot restaurants. The most spiritual artist need not altogether keep away. There is a taste in the stout jars and bottles that allies them to genuine ceramics, and a feast of color in the cordials, the white double beer of Bruges, the spice bread, the *pièces montés* of the confectioners, the sausages of Bologna with the silver paper half unwrapped, not to be overlooked.

For our part, we show cottons, tobaccos, packed meats, specimens from the Bonanza mines—the universally respected products we so easily get together. There is no excuse for a façade like one of the poorest of the State headquarters at the Centennial, since if we have no national style we have designers of ability; but one comes at last to being reconciled to our narrow strip of exhibit, which was at first disappointing, and taking quite an interest in it. It is compact in things of solid usefulness, while some others resolve themselves finally into taking curtains and ingenuities of wine bottles.

This must do for the main building, apart from the pictures, which I have purposely omitted. The illumination in the great interior, from above, sifted through canvas screens, is agreeable. The floors are kept clean and cool with watering pots. Sometimes, in remote alcoves, you are alone, except for a leisurely attendant who emerges from behind a case with a dust-brush. A piano tinkles, as if playing a delicate accompaniment to your acquirement of information. But it is the indefatigable passage of feet, and their grind, grind, grind, upon the gravel all day long, that is the normal accompaniment. You think that intelligence is kindled by this laborious friction, as the gas may be lighted after sufficient shuffling round over a thick-piled carpet.—*Atlantic Monthly*.

A NEW bleaching process for silks, of which brief mention was made some months ago, has attracted some attention at the Paris Exhibition. It is the method employed by Girard. A bath of weak hydrochloric acid removes all calcareous matter, and caustic soda of the strength of 2° B., followed by rinsing, removes the "gum." Baths of weak hypochlorite of ammonia, the passage of the material in hydrochloric acid, a bath of slightly oxygenated water, and rinsing complete the work. Part of the bleaching is performed in the cold, and the time required—sometimes several days—depends on the nature of the material.

THE PROPER CLIMATE FOR CONSUMPTIVES.

DR. ALFRED L. LOOMIS, in a paper on "Climatic Treatment of Pulmonary Phthisis," lately read before the American Medical Association at Buffalo, states that during the past ten years his advice has been given to a large number of persons suffering from pulmonary disease. Under his direction pulmonary invalids have taken up their residence for a longer or shorter period in nearly every well-known health resort on this Continent. He has sent but few such patients to foreign countries, since within our own boundaries may be found every diversity of climate.

From these experiences he has reached the following conclusions:

First.—That permanent improvement in cases of developed phthisis can be expected only after a prolonged residence in the locality which experience has proved to be best suited to each individual case. No permanent favorable results can be obtained from an annual change of climate.

Second.—That cases of *tubercular* phthisis, in any stage of the disease, grow steadily and rapidly worse in all localities. Such cases do best in the quiet, well-ventilated apartments of their own homes, where they can be surrounded by all those influences which tend to make a feeble invalid comfortable.

Third.—That cases of *fibrous* phthisis in every stage, even after retraction of the chest walls, especially in the infraclavicular region, is well marked, and the bronchial dilatations which accompany it give the physical sign of extensive cavities, improve and often reach a condition of comparative health, when they take up their residence in regions having a very high altitude, such as are found in Colorado and in the Rocky Mountain range.

The benefit derived in these regions by persons suffering from asthma or emphysema, is very marked. He knows no locality where these classes of pulmonary invalids make such rapid and permanent improvement. But experience has led him to be very cautious in recommending these regions of high altitude to invalids with *catarrhal* phthisis. In the advanced stages of this form of phthisis, he has never observed any good results from a residence in such regions, and it is quite doubtful whether any one in its first stage has received any benefit.

The majority of cases of pulmonary phthisis are undoubtedly of the catarrhal variety, and it is in giving advice as to the climate and locality best suited to this class that the greatest experience and judgment is to be exercised by the medical adviser.

One thing seems certain, that after the stage of softening and excavation is reached by this class, no climate will long delay the fatal issue. It is during the stage of pulmonary consolidation, or during the period of enfeeblement that precedes it, that permanent improvement, and perhaps final recovery, may be expected. He has seen very few cases of catarrhal phthisis permanently improved by long sea voyages or a residence in a warm climate. In the early stage of this disease, a large number going from a northern to a southern winter are temporarily improved; but after the first apparently beneficial effects are passed, the degenerative inflammatory processes go on more rapidly than before. The invalids who receive the most marked benefit from a sojourn in a southern climate during winter are those convalescing from some acute pulmonary affection, and in whom the delayed convalescence raises the fear of possible phthisical development, and those in whom acquired or hereditary phthisical tendencies exist; yet these may be no positive physical signs of lung disease. His favorite resorts for such cases are Aiken, S. C.; Pilatka, Enterprise, and Gainesville, Fla.; and Thomasville, Ga. In the stage of consolidation of the catarrhal form of phthisis his best results have been reached in those who have made a prolonged stay—varying from one to three years—in mountain regions with an elevation of from 1,500 to 2,000 feet. Of such regions the most positive and permanent results have been obtained in Asheville, N. C., and in the Adirondack regions of New York. Persons suffering from catarrhal phthisis do not do well at a higher elevation than 2,500 feet, and some regions with a much lower elevation afford all the necessary climatic conditions for this class of cases.

The mode of life which those suffering from phthisis should adopt is important. The general direction is, "Live in the open air." Dr. Loomis, from his own personal experience, as well as his experience in regard to its effects upon others, is led to believe that a camp life, or a tent life during the warm season, in such localities as have been indicated, is of the greatest service in arresting and curing phthisis in those who are not enfeebled. If this kind of life is not practicable, or the invalid's condition renders it hazardous, then spending the day in the open air in pleasurable excursions should be encouraged, even in the feeble.

IN order to distinguish artificial alizarine from extract of madder, Goppelsroeder sublimes the dried sample, and examines it with the microscope. All artificial alizarines yield, along with long orange-red needle-shaped crystals of alizarine, a greater or less quantity of anthraquinone in light-yellow crystalline leaflets shining like mother-of pearl; or the coloring matter is extracted with a boiling solution of alum, the liquid is filtered while still hot, cooled and filtered again after the greatest part of the alizarine has separated out. Extract of madder displays the well-known fluorescence of purpurine, while alizarine paste does not.

"CURCUMINE."—On inspecting the Paris Exhibition, we found in an isolated show-case this new product. We have obtained a sample, and now communicate the result of our experiments. Curcumine gives a fast dye on wool and silk, and its tinctorial power is great; seventy grains are sufficient to dye two and a quarter pounds of wool a medium shade of yellow of a pleasing orange cast. It gives shades which are not affected by friction or by exposure to the air. Alkalies do not affect it, and acids merely increase its brightness. Its price is £1 0s. 10d. for 2 lbs. 3 ozs.—*Le Teinturier Pratique*. (The exhibitor of this new color, whose name is omitted, would have done well, says the *Chemical Review*, to have selected for his product a name less confusing. Under curcumine any chemist would naturally understand some principle extracted from turmeric (*Curcuma*). But the properties above ascribed to "curcumine" utterly negative the idea that it can be derived from turmeric.)

NEW DYE.—A new and permanent red dye, which jute will take and retain, has just been invented by Mr. Butler, an American manufacturer of tapestries. The great difficulty in all hemp carpets heretofore has been the lack of brilliancy and durability of the red. This has now been overcome, and the new color will doubtless greatly increase the attractiveness and salability of this class of goods.

BRIGHT'S DISEASE CURED BY JABORANDI.

Clinical Lecture delivered at the Pennsylvania Hospital, by J. M. DACOSTA, M. D., Professor of Practice of Medicine in Jefferson Medical School.

A. W., æt. 55; single. Admitted on March 20th. Has never suffered from rheumatism, and has never had any specific disease. Has always been regular in her courses. The patient states most positively that she has been perfectly well all winter, and that her illness only began one week prior to her admission. She then noticed that, being exposed to the vicissitudes of the weather, her feet and then her face began to swell. Finally a general anasarca came on. She had at the same time some loss of appetite, with gastric pain and cough. When she was admitted to the hospital her whole body was greatly swollen, and she was somewhat feverish, the temperature in the mouth being 99°. The heart was beating feebly, or rather the sounds of the heart were feeble. She complained of pain and weight in the pit of her stomach, and of considerable dyspnœa. She passed but little urine. There was no heart murmur to be heard, although we made a very careful examination of that organ. The tongue was clear, and the digestive disturbance not much marked.

What was the cause of the dropsy? A clew was at once afforded us by an examination of the urine, which was found to contain an enormous amount of albumen, the albumen when precipitated filling at least one-third of the test tube. The microscope taught us that the urine also contained blood corpuscles, epithelial and hyaline casts, and a few oil drops. Most of the casts were, however, epithelial.

I at once diagnosticated the case as one of acute Bright's disease—Bright's disease complicating acute renal dropsy. All this was self-evident. Only one doubtful point remained to be cleared up. Was or was there not prior organic disease of the kidneys? This was at first hard to determine off-hand. We had to wait until the acute attack had passed away under the proper treatment. The presence of casts and blood corpuscles in the urine seemed to answer the question in the affirmative at that time.

To-day we have the best of reasons for concluding that no disease of the kidneys pre-existed. The case has ended in perfect recovery. The abnormal constituents of the urine have almost entirely disappeared. This case has been an extraordinary one, on account of the patient's very rapid recovery.

And now you will of course want to know what our treatment has been—how we have brought it about that in the course of two weeks after her admission the patient is entirely recovered—the general dropsy, albumen in her urine, and dyspnœa all gone together. I ascribe all my success in the treatment of this case to the free use of jaborandi. Five days after the jaborandi treatment was begun the whole face of the case was changed. The dose I ordered was one drachm of the fluid extract of jaborandi thrice daily. This dose produced excessive diuresis and diaphoresis. I am convinced that in jaborandi we possess a most valuable agent for combating the dropsical complications of Bright's disease.

It should be given either in the form of the infusion or the fluid extract. In cases where uræmic poisoning is a factor, and where the drug is consequently not well borne by the stomach, I have administered jaborandi by injecting it into the bowel. Though the effects of the drug when injected were not so striking as in the present case, I yet see no reason why it should not be given by the bowel as well as by the mouth. I have also tried the drug hypodermically, but I prefer not to speak positively at present of its effects when so used. In one instance I will say that it did produce considerable irritation of the skin.

How are we treating this woman, now that the dropsy has all gone? She is taking dialyzed iron internally and hypodermically. This treatment is improving vastly her general health and nutrition.

The origin of the disease in the present case is a very common one. It was brought on by cold and exposure. In children, acute Bright's disease generally follows scarlet fever. In adults it usually comes on immediately after exposure to dampness and vicissitudes of weather.—*Hospital Gazette.*

DIPHTHERIA.

By W. N. THURSFIELD, M. D.

IT is my experience that the disease spreads solely through the ordinary channels of infection, and is not disseminated by means of mysterious atmospheric agencies, as is too frequently assumed. Diphtheria is, like other infectious diseases (perhaps more so), subject to an increased tendency to spread at one time more than another, owing to influences which, though probably connected with the individual, for want of a better name we call "cosmical." But, under ordinary circumstances, it has seemed to me that diphtheria is a very tangible and controllable infection, and that the distance through which the infecting agencies can travel through the air without becoming inert is very short.

Of this I recently saw a striking example. Diphtheria was brought into a village, and, the first case being mild, grew into an epidemic before the village day school was dissolved. In this village was a large school where pauper children from various unions were boarded and educated. This class is certainly not the least susceptible to infection in the community. Now, although several cases occurred within a few yards of this establishment, and a great many in the village, not a single case occurred in the boarding school.

The infecting element is probably given off in chief from the throat with the breath, or with the expectoration, and may thus get conveyed to the sewers; but, having regard to the observed pathological fact that the specific inflammation may, to a greater or less extent, spread over the digestive and even the urinary tracts, we need go no further to find a ready means of accounting for two modes in which the infection gets disseminated, namely, through specific contamination of sewers, and of collections of excreta in latrines. Of both these modes of dissemination, especially the former, I have seen many marked instances.

On one occasion, when called to investigate a case at a detached and perfectly isolated house in the country, I found the patient had been to a neighboring town and had entered and been exposed to sewer gas in a house on a short line of sewer which I knew had become specifically contaminated by diphtheria. The owner of the property instructed a surveyor residing some little distance off to examine this sewer. He did so, and for that purpose had it opened, and was much exposed to the gas, and the second or third day after I received information that he was struck down with an attack of diphtheria, from which, and from its more remote sequelæ, he has suffered severely.

As regards its dissemination by sewer gas, diphtheria has seemed to me to follow precisely the same laws as typhoid fever, especially in the fact that they both will attack with greater virulence and readiness new comers to an infected neighborhood. From the latrines and sewers the *materies morbi* may readily, in some cases, obtain access to wells, which I believe may become specifically contaminated, though I have not absolutely proved it. In such cases the infection may be disseminated by the water, and therefore, like typhoid fever, by means of milk or any other fluid with which the milk may be mixed. Apart, however, from any question of admixture with impure water, having regard to the readiness with which milk absorbs volatile organic matter and the infecting material of certain diseases by mere exposure to an infected atmosphere in a confined room, and to the apparently tangible nature of the infecting elements in diphtheria, I believe that milk which had been kept in a house infected with diphtheria would form a ready mode of disseminating the disease.

The infection is most portable. This is a very important point which has generally been either overlooked or disputed altogether. I have no doubt about it whatever, and indeed I believe the infection of diphtheria to be as portable as that of any disease with which we are acquainted. I have known it taken to a house by a person living in an infected house, but not at any time suffering herself, but who went to visit a person a mile or two off, involving a considerable walk and a passage by ferry across a river, and only remained a short time in the house, but sufficiently long to leave the germ of diphtheria, which broke out a day or two afterward.

I have known it taken from one house to another a long distance off, and between which there was no other connection, or indeed any possible source of infection, by a woman who had simply been to fetch some yeast. Other remarkable instances I could give if necessary. The infection can certainly be taken from a corpse, or at least from its adjuncta, and, as in the case of small-pox, I believe it is specially liable to spread from such a source. I have known a coffin maker take the infection home to his children after measuring a corpse, and another instance in which a woman who went to help to make shrouds contracted the infection. The infection will not only remain in unscavenged collections of excreta, and in the air of closed sewers, but will attach itself to articles of clothing and furniture, and most persistently to wall facings, and indeed seems to have a special predilection for so doing.

From the above it will be seen that, although the modes of dissemination of diphtheria are numerous, powerful, and subtle, there are none which do not admit of being controlled by disinfection carried out with precision. Of all diseases this is one most liable to be spread by schools, and the reason, I think, is not far to seek, because the disease is frequently so mild as not to keep children from school, and may present no external indications. Moreover, the infection is peculiarly liable to be spread by the breath, and may indeed, I believe, remain and be disseminated by the throat after children are sent back to school apparently well. I would suggest as a matter of ordinary practice that as soon as any cases of infectious sore-throat have occurred in connection with a day school, that school should be closed for a sufficient number of days to cover the ordinary period of the incubation of the disease. For this purpose one week would be sufficient, provided the school walls and latrines are thoroughly cleansed, and the utmost caution observed in readmitting convalescents.

ORIGIN OF DIPHTHERIA.

I wish to avoid expressing a belief in the *de novo* origin of disease, as that doctrine is commonly understood, but the arguments in favor of that view are far stronger in the case of diphtheria than in scarlatina or typhoid fever, and while, as regards the two last-named diseases, the number of cases in rural districts in which you cannot directly trace the source of infection is not more than would be anticipated on the theory of probabilities, with diphtheria the case is far otherwise, and all who have been called upon to investigate many outbreaks of diphtheria must have met with cases in isolated houses which seemed to admit of no other explanation.

The researches which I have made in reference to these cases in old registers seem to me to show clearly that in all these cases, if we trace the habitations far enough back, we shall meet with previous outbreaks in the same house, and there are certain parts of the country where diphtheria may be said in this sense to be endemic, and where certain houses can be shown to have suffered repeated attacks at intervals of years. Now it is my experience that there is one condition in common to all these places, needing only an exciting cause to bring and develop diphtheria. That this exciting cause need not be the importation of the specific infection of diphtheria I am confident, though if imported into such a locality diphtheria will flourish most vigorously. The immediate stimulus is to be found in the individual himself, and I believe under certain bodily conditions an ordinary cold is sufficient.

I have repeatedly seen typhoid fever imported into such a locality give rise to an outbreak of diphtheria instead of typhoid fever. I have at least on one occasion seen scarlatina do the same. I have also seen a convalescent from parturition develop and spread diphtheria, and I have once seen it follow an injury. The disease is infectious from the commencement of the outbreak, but the power of the infection appears, as I have pointed out previously, to be occasionally intensified by circumstances connected with the individual.

As typhus fever in its incidence and endemic form is connected with dirt and overcrowding, as in the same way enteric fever is connected with sewer gas, so diphtheria in its incidence and endemic prevalence is specially connected with dampness of habitations. Whether these results are from development of a specific disease on the application of a certain stimulus to a favorable soil, or from the infection of previous attacks remaining dormant and revivified by the same stimulus, is a question easy to speculate upon, but difficult to decide.

Space, however, will not allow me now to pursue this subject further, which is perhaps all the better in a paper intended to be above all things practical.

The chief points I have wished to bring out are:

That diphtheria everywhere prevails inversely to typhoid fever, with which disease it is closely allied, although an attack of typhoid fever affords no protection from a subsequent attack of diphtheria, nor *vice versa;* that when introduced into a town diphtheria may become epidemic, and be disseminated by precisely the same channels as typhoid fever; that the infection may be conveyed into any house by sewer gas, or otherwise, altogether irrespective of dampness of structure, but that its endemic breeding grounds are to be found in certain well-defined spots in rural districts, where it is constantly liable to break out as if *de novo*, and that the constant condition of these localities is structural dampness of habitation.—*Lancet.*

DETECTION OF BLOOD UPON DYED AND DIRTY TISSUES.

IF a spot of blood has dried upon a colored tissue it is difficult to demonstrate the formation of crystals of hematin unless the spot is large enough to be removed mechanically. If the spots are small and the blood has been absorbed by the tissue it is necessary to steep the portion of cloth either in lukewarm water, ammonia, acetic acid, etc., and it often happens that the dye dissolves at the same time, and hinders the formation of the characteristic crystals. The author has observed that the tungstate of soda and acetic acid precipitate foreign matters along with the coloring matter of the blood, and has examined if the color matter of the blood not dissolved would yield crystals of hemine. For this purpose, the precipitate, filtered and drained, was put in a suitable vessel along with alcoholic ammonia, prepared with 8 vols. of absolute alcohol and 1 vol. of concentrated ammonia. After being left in contact for several hours the liquid became slightly colored; on concentrating it gently to a small volume, and then further evaporating it upon a plate of glass and adding to the dry residue a drop of acetic acid and a drop of solution of chloride of sodium, crystals of hematin were obtained by the ordinary process.

ON SYSTEMATIC EXERCISES—THEIR VALUE IN THE PREVENTION OF DISEASE.*

By EDWARD T. TIBBITS, M.D., London, Physician to the Bradford Infirmary and the Bradford Fever Hospital.

IN introducing this subject I do not for a moment imagine I shall disclose any great novelty, but it is quite possible the importance with which I have regarded it may be considered by some persons exaggerated, unproven, or altogether fanciful.

It will be universally admitted that *properly regulated* exercise is absolutely essential for the preservation of that valuable combination, "a sound mind in a sound body." Should the exercise become deficient (which is by far the most frequent error), excessive, or irregular, unsoundness of mind or body to a greater or less extent is a natural, common, although, perhaps, not invariable consequence.

Now, it must be borne in mind that our function as medical men is mainly of a twofold nature—viz., (1) to prevent disease, and (2) to cure it; and although I believe systematic exercises are extremely useful in the treatment of disease, it is only possible during the time at my disposal on this occasion to place before you an imperfect sketch of what appears to me their real *hygienic* value. Their sanitary influence may be considered to spring from two sources, the direct and the indirect, to the latter of which I propose mainly to confine my remarks.

And, firstly, a few words concerning the direct physical, or chemico-physical source. The direct beneficial effects of exercise are acknowledged by all men—lay as well as professional; nevertheless it is a fact, especially as regards its *systematic* character, which is practically ignored by a very large number of individuals. Without entering very minutely into details, I will simply enumerate some of the more important effects of exercise. (1) It increases the action of the skin, lungs, bowels, and kidneys—*i. e.*, those organs specially intended for the separation and removal of effete material. (2) It increases the quantity of heat within the body, although it probably does not produce much, if any, elevation of temperature. (3) It produces inspissation of the fluids of the body, and hence absorption of food takes place more rapidly and with greater facility. (4) The determination of blood to the muscles during exercise, to a certain extent, drains the viscera, and, as a consequence, they perform their respective functions more efficiently when called upon to do so.

In a few words, the probable, although perhaps not immediate, effect of the judicious systematic exercise of which I am now speaking is the production of a more thorough and rapid tissue change, in conjunction with an increased and more efficient functional activity of all parts of the body. Here, I think, it will not be out of place to refer briefly to the principal conclusions at which Dr. Pavy arrived in his interesting investigations on Weston, the pedestrian. He says: (1) That, although there is a greater elimination of nitrogen during severe exercise than can be accounted for by increased nitrogenous food, the motor power does not arise from oxidation of muscular tissue; and the greater proportion of nitrogen eliminated is probably directly derived from metamorphosis of nitrogenized ingesta, without passing through muscular tissue at all. (2) That, supposing the elimination of one grain of nitrogen to represent about 2·5 foot-tons, it was calculated that the nitrogen eliminated was only sufficient to account for about half the force expended. It is natural, therefore, to conclude that a considerable quantity of force must be developed from consumption of hydro-carbonaceous food. I may mention that Weston's work during his six days' walk represented nearly 1,200 foot-tons per diem. According to the late Dr. Parkes, 500 foot-tons is an extremely hard day's work. "Every man," says the same writer, "ought to take an amount of daily exercise of some description equivalent to about 150 foot-tons, or a nine miles' walk." It must not be forgotten that although there are comparatively few individuals who make a point of actually walking nine miles daily, there are many who do an amount of work, in some form or other, equivalent to that walk. (3) That increased exertion requires an increased quantity of nitrogenous food. (4) That, with the exception of chlorine, sodium, and magnesium, there is a great increase in all the mineral ingredients in the urine, the most notable being phosphoric acid, which is nearly doubled during severe muscular exercise.

But, secondly, I believe that important salutary changes may be effected in the human body from what may provisionally be termed the indirect or physico-mental source. Without venturing to make too sweeping an assertion, I think it will be found, on strict and impartial investigation, that the following proposition is substantially correct:

I. That much disease arises, directly or indirectly, from excessive indulgence in the gratification of the senses and appetites, or some form of selfishness.

Disease arising from an action, or a line of action, which is pursued altogether irrespective of others, because it is a source of pleasure to the individual performing it, is, I believe, much commoner than appears at first sight, or than we should be inclined to admit. I will not attempt to enu-

* Paper read before the Leeds and West Riding Medico-Chirurgical Society

merate the different diseases which are constantly springing out of some form of excess, many of which do not admit of any doubt. From the crown of the head to the sole of the foot, commencing with the various forms of cerebral disease, and terminating with what I presume may be called that agonizing complaint of the great toe, I think it will be found that deficient self-control stands in a very prominent etiological position. But it may be urged that excess in all its forms has not so very much morbid influence, otherwise the amount of disease would be more commensurate with great prevalence of bad habits. There must be a peculiarity of constitution, or a something else, to produce the effect. Most likely; but at the same time, if we have positive evidence of the sequence in ten or fifteen per cent. only, it is not irrational to infer that the ratio in all probability is considerably greater, although incapable of positive demonstration. If it were possible to strike six persons on the leg in the same spot with the same weapon, and with exactly the same amount of force, it would not be surprising if results differed somewhat in each case. Perhaps in one or two instances only the leg might be fractured. Would it, therefore, be logical to say that, after all, the blow had not very much to do with it? But, independently of the direct origin and propagation of disease in this manner, are there not many undoubted morbid tendencies produced by drunken parents neglecting to make proper provision for their children? May not the spread of many of the exanthemata be traced to the selfishness of parents, schoolmasters, and owners of property? Can we not detect in marriages of consanguinity and the union of delicate individuals a certain amount of selfishness, although it may be disguised in the garb of expediency? And what other word so aptly expresses the conduct of that mother who forsakes her own child for a time, and places it on the breast of a stranger, in order that she may indulge in the festivities of the ball room or some other form of entertainment? Is this one of the signs of progress and civilization? Is it natural? Is it human? Is it right? In very truth, it appears to me the most unnatural thing in nature. Even if the foster mother be sober, it is not unlikely to lead to increase of disease. It is well known what a powerful influence anger, grief, etc., exercise over the quantity and quality of the mammary secretion. Notwithstanding those who are skeptical on this point, I feel thoroughly convinced that the state of the nervous system in the mother when she is suckling does affect the health of her child, not only in body, but most probably in mind also. It is not to be expected that the foster parent will display that tender emotion toward her nursling, or be so anxious to control her feelings and passions, as the true mother. And is it not reasonable to suppose that the feeling of exquisite tenderness exhibited by a truly natural mother toward the infant at her breast must have a certain appreciable value in its nutrition and development?

It appears strange, although probably familiarity with the danger makes us despise it, that we do not sufficiently appreciate the fact that much disease is directly produced by disregarding laws of nature as plain and invariable as those of gravitation and motion. Is it likely that we shall escape disease if we constantly act and encourage action which we know will assuredly produce it?

If the first proposition be correct, the second follows as a matter of course.

II. That by a more frequent and thorough exercise of the inhibitory power of the will much disease might be prevented.

This requires no comment, as it is self-evident.

The third proposition, which embodies the main point of my paper, is as follows:

III. That the efficiency and power of the will may be materially increased and strengthened by systematic exercises.

Before endeavoring to prove this it will be necessary to make a few preliminary remarks on the constitution of the mind. It is supposed to have, if I may so call it, a trivet nucleus—*feeling*, *thought*, and *volition*—not three distinct nuclei, but one nucleus, divided into three portions, united together. For the sake of argument, let us presume that these three portions are equal in a perfectly well developed and well balanced mind. The different phases of human character met with in our journey through life depend in a great measure upon the proportion in which these three elements of the mental nucleus are combined. For example, one individual is over-sensitive, another is so much absorbed in thought that ordinary matters are overlooked or disregarded, while a third carries out the dictates of his will almost irrespective of his own feelings or those of others. With regard to volition, it is important to bear in mind how intimately it is connected with muscular movements. Commencing in intra-uterine life, and increasing at birth, by degrees, after numerous unsuccessful attempts, muscles, and groups of muscles, move in obedience to a wish. Voluntary observation and adjustment are followed by voluntary control; and, finally, the control of the feelings and thoughts completes the superstructure erected upon, and developed from, the purposeless movements of the infant.

(*Concluded in our next.*)

A MODEL FARM IN NORMANDY.

THE attention of French agriculturists has been drawn toward the extensive improvements which the owner of the domain of Amfreville, situated in the neighborhood of the pretty town of Louviers, in Normandy, has introduced upon a model farm erected upon his estate, of which some well-finished and carefully executed plans and models are now being exhibited at the Paris International Exhibition. An old castellated mansion of great architectural beauty, its principal façade washed by the waves of the river Iton, stands almost in the midst of the domain, which, besides two farm establishments and a pulling or walk-mill, contains an area of fields, meadows, and forest to the extent of ninety-two hectares, or about 240 acres. The buildings of one of the farms established upon the estate having recently been rebuilt and provided with all the most practical improvements, these excellent arrangements are described in the *Landwirth*, as follows:

The farm buildings represent the form of a square. The principal edifice, from which all the other structures can be overlooked, has attached to it two wings, of which one is destined for the dairy, and all its attendant necessaries. It contains everything required for keeping the milk and dairy produce, such as a milk-chamber, a skimming room, provided with a mechanical churn, a refrigerator or cooling-room, and arrangements for saving and drawing off (for feeding the pigs) of all the waste and refuse from the milk products, etc. The milk and skimming rooms are, during the hot season, provided with fresh cooling air by means of a continual flow of water over the pavement, while some very practical provision is made above the bottom and below the ceiling of the rooms for ventilation and an equalized change of air. The other wing contains a vine and cider-press, potato-cellars, granaries, storing vaults for fruit and provisions, and divers other rooms.

To the left of this wing are situated the stables for the farm cattle. The cows are placed—eighteen in each stable—in such a manner as to leave a broad passage both at the front and the back of them; the animals are fastened to oak posts, with chains of movable rings or links, and enjoy complete liberty of movement. Special resting-places are provided for calves and cattle selected for fattening. Stone drains run through the whole length of the stables, at one end of which iron stairs lead up direct into the hay-loft. The arrangements of the horse stables, just opposite the cows' stables, containing room for four horses, are quite as much to the purpose, with saddle and harness room, coach-house, and forage rooms in immediate connection with them. The racks are of iron, as well as the cribs or mangers, the latter being divided by a partition into two parts, the one to hold oats, the other some water at the same time. The horses have the same large comfortable quarters as the cows, access to them being possible without their being disturbed or in any way alarmed. The same is the case with the pigs, the pig-sty being surrounded by a large yard, in which there is a pool, the water of which can easily be drained off or renewed at any moment. The free space between the different stables has been used for the construction of a covered up manure receptacle or cistern, holding some 6,000 liters, or about 1,250 gallons, constructed of cement, and provided with a pumping apparatus, which receives all the fluid matter flowing into it from off the stone drains in the stables.

The whole of the establishment is amply provided with excellent water, collected from a dug draw-well into a basin holding 60 hectoliters, or about 1,350 gallons, and from there distributed through direct conduit pipes into the different localities of the establishment, and wherever it is required.

A proceeding for the purpose of reducing manual labor, seldom and very little employed as yet by the agriculturists or large landed proprietors, has been introduced into the Amfreville model farm. This is the employment of gas, not only for lighting, but also for mechanical purposes, services in the kitchen, and for providing vegetable force. The erection and maintenance of an ordinary gas establishment being too expensive, and requiring too much labor and carefulness, the new system of producing gas, such as has recently come into use in many of the industrial establishments of Switzerland, Alsace, and France, was decided upon. The gas is produced from petroleum by means of a very simple apparatus requiring but a very limited space and but little attendance. All danger of any explosion or of the petroleum catching fire is excluded. The cast-iron retort is not larger than an ordinary cylinder-hat, and does not cost above ten francs. The gas produced is quite free of all noxious matter, and does not show the destructive influence upon many subjects, as in the case by gas made from coal; besides being without the least smell, if kept in clean condition. The petroleum gas is, however, more expensive than that produced from coal, but its lighting power has three or four fold the strength of that of ordinary gas.—*Land and Water.*

AGRICULTURAL PLANT FEEDING.

By E. LEWIS STURTEVANT, M. D.

[From an Address before the National Agricultural Congress, New Haven, 1878.]

SINCE variation seems to be the law of nature rather than likeness, the subject of plant fertilization is approached with some diffidence, recognizing that agriculture is a complex art, dealing with the circle of the sciences. The appropriation of plant food by the different varieties of plants depends upon the hereditary quality of the seed, meteorological changes, the proportion in which the element of the food supply exists, and the variation in temperature. In fact, the complete consideration of plant fertilization should include the plant, the soil and the acts of the husbandman as influenced by natural laws and forces.

Concerning the systems of plant fertilization in this country, we find, generally speaking, in the East, manuring with farm dung assumes the greatest prominence; in the West a general robbing of the fertility of the land, and in the South a dependence on artificial fertilizers. As all of these systems are practiced with more or less success, the question naturally arises, What is this plant food? The reply comes that it is inorganic, and experience tells us that all agricultural soil contains all the elements in sufficient quantity for the needs of agricultural plants, with the exception of three—nitrogen, phosphoric acid and potash. For agricultural supply of these ingredients we have recourse to dung, to guano, to chemical salts, as sulphate of ammonia, nitrate of soda, sulphate of potash, chloride of potassium; to superphosphates, made through the action of acids on bones or mineral phosphates; to various wastes of manufactures, as wool waste, slaughter-house refuse, etc. The profitable use of all or either of these depends on the amount of nitrogen, phosphoric acid or potash, or combinations of the same, contained in them, in a form suited for absorption by the plant.

The plant does not obtain all the plant food we apply, because in order to feed, the plant has to come in contact by its roots with the soluble food in the soil, and as the roots do not occupy all the soil interstices, and as the food supply does not always remain continually in one place or in the proper form during the entire growth, there is practically a loss of contact between the plant and its food. We will briefly state a few of the proven properties of our three elements in connection with the soil reactions. In water form nitrogen is applied to the soil, and nitric acid is the ultimate product. Nitrogen is one of the most important, usually the most important, of the elements to be supplied to the farm, as being subject to waste through the processes of nature, and as not realizing a permanency of condition after being applied.

Phosphoric acid is a constituent of all agricultural soils, and occurs in three forms as combined with different properties of lime. Since it is subjected to many changing influences, the necessity exists of continued applications to insure its presence in a soluble and active form. Potash is usually present in sufficient quantities for plant food in the majority of our soils. It is retained by the soil with considerable tenacity, and is practically but little subject to waste. It seemed to serve a destined purpose in the plant, and is possibly concerned in the transfer of nutriment as organized in the leaf to the matured grain of cereals. It matters not to the farmer whence the source of these three substances, provided they reach the plant properly, so as to be appropriated.

As a practical illustration of the difference in the availability of plant food, even in soils where it exists, owing to the different depths at which the elements of fertility may be situated, through the influence of rains, drainage and cultivation, we will say that the wheat plant, being a deep feeder, should not be used on a worn and northern pasture with the expectation of large results, while the corn crop may be grown with almost a certainty of success on such land, provided either dung or a complete artificial fertilizer be furnished it. That for the corn crop under conditions that admit of the roots going downward as on a light soil, shallow plowing, which keeps the fertile element of the soil near the surface, is preferable to deeper plowing, which places them further from the surface-feeding roots of the crop and the warmth of the sun; while, on the contrary, for wheat, deeper plowing under proper conditions seems advisable. It is the feeding of the plant, rather than the giving to the soil, that concerns us the most.

The plant food being present in the soil, it should be the farmer's effort, through the agency of the plant, to turn it from dead capital into active capital. Hence the importance of selecting the plant with reference to the soil and its plant-food condition. Thus we see that the tendency of nitrogen applications in excess is to develop foliage in the plant, oftentimes to such an extent as to divert the plant from the production of seed. The special influence of phosphoric acid seems to be to increase the small feeding root-fibers or rootlets, and thus increase in the plant the assimilation of plant food in the direction of the crop designed, the bulbs in turnips or the grain in corn. The potash supply seems to have little inherent influence on plant growth, but to influence plant quality, acting in some way to aid in the transference of matter within the plant.

Hence, we see that, such is the complexity of conditions that meets the farmer who strives to solve the problem of maximum crops at minimum cost, the best of our present intelligence is unable to cope with conditions of practice with unfailing success, and hence the necessity of that education of the farmer which shall lead him to the consideration of principles rather than empirical directions. We will now consider the principles which should govern the farmer in the application of plant food to his land as a farm practice.

We will first mention faith in the law of nature. The farmer needs, in the fertilization of his field, to possess the firm belief that nothing is lost or destroyed, except in the relations between himself and his land, and hence whatever is applied should admit of being accounted for either by return in crops, by change into insoluble form, or by drainage into the sub-soil or waste of a similar purport. The correlative of this is, that as something cannot come from nothing, there is no use to expect a crop without the materials which are needed for the crop being at hand, and that those crops which draw the most from his land should yield the most profit. Hence, that a crop is an exhaustive one, so called, should be rather in favor of its planting than otherwise.

Second.—That the natural fertility of the land, or that amount of plant food set free through natural agencies from insoluble combinations already existing within the soil, is the most valuable kind of fertility to possess, and is the only fertility in practice which is obtained without direct payment. This natural fertility may be increased through operations of culture, as through fallows and tillage; may be conserved in part over a season, by the use of green manuring, and may be rendered more immediately available through the practice of judicious rotations. Only naturally good agricultural land develops this power of fertilizing itself through the agencies of nature, and hence some lands assume an agricultural importance over others. Poor land may become rich through artificial fertilization, but can never equal for profit good land brought to an equal condition through applications of plant food. The adjectives good and bad are used here in an agricultural sense.

Third.—Whenever plant food in a farm, available for plant feeding, can be purchased and applied at a less cost than the same elements will sell for in the organized form of crop, there is opportunity for profit. Under the common system of farming within a circle, viz., manure to raise crops, cattle to eat the crops, and furnish dung for reproduction of crops, the farm profit consists in the sale of the natural fertility of the land, which is organized by the plant, and sold as surplus produce either as meat, milk or crops. Hence the natural fertility of the land under this course must in the long run measure the profitable returns from lands under like management. When, however, the farmer abandons this rut, and purchases supplies from off the farm, either of foods which are to be converted into dung, or directly as fertilizer, he assumes the functions of a manufacturer, and increases his profit by the manufacture of crops from the raw material at a low price, to be sold at a higher price, and hence enables his farm to pay a double profit—that of the farm, and that of the farmer or manufacturer. In accordance with the skill of the farmer as a manufacturer will be the added profits to the natural profits derived from the soil.

Fourth.—Under the pressure of increased population, and exhausted soils, the manufacturing functions assume a greater and greater prominence on the farm. Already, under these circumstances, the English farmer has come to depend for his success upon the purchase of artificial fertilizers or feeding substances. The natural fertility of his lands but suffices to pay the rents, and the profits must be derived from the skill used in buying and manufacturing substances from within the farm, using the farm lands as the manufactory. In this way the English farmer succeeds in securing his investment and living, changing bone and superphosphate, nitrate of soda, guano, feeding meals and cakes, etc., from all portions of the globe, into the more valuable commodities of mutton, beef, wheat, etc. In the Eastern States, under the pressure of rents, the same condition of affairs would plainly appear, and as it is, it is very evident to the observing man that the nearer the Eastern farmer approximates to the principles of the English system, the more prosperous he appears as a farmer. The Western farmer has the natural fertility of his land to serve his purpose, and is not as yet pressed to the wall; but in the South, the natural fertility of the land is not sufficient to afford adequate profits, and the modern system must prevail more and more as growing intelligence, greater wants, and increased population render the old system insufficiently profitable. It is this idea of the *farmer as a manufacturer* which is to dominate over successful modern agriculture.

Fifth.—That it is not in the names of dung or fertilizers that the farmer must pin his faith, but in the supplying his plants with available plant food at the least cost. That the

neglect of the manurial matter furnished by the farm is a folly, as the dung is a waste of the farm, and hence costs nothing compared with its value as a plant food, when furnished under the ordinary conditions; that when this dung is rendered so expensive through composting and handling that its plant-food value is less than the cost which it has incurred, then its use at its value can hardly be economical; and, likewise, the purchase of dung from others at a cost greater than its plant-food value cannot be safely recommended, except under a few special circumstances which do not appertain to the ordinary farm economy. Here, likewise, we must refer to the subject of composts, which, however valuable for the garden, can never be recommended for the general farm, unless under a few exceptional circumstances, on account of the cost incurred in their preparation and distribution, being usually greater than the profit to be derived from the crops grown by their use will warrant.

Sixth.—That the efficacy of fertilizing applications is governed largely by the method of application, the past history of the field, the character of the land, of the average season, of the crop to be grown, and the hereditary quality of the seed used. This is established by the fact that upon all these elements of knowledge and experience depends the access of the plant roots to the fertilizing application, and the appropriation into the plant organization.

Seventh.—That there can be no exact comparison between unlike objects or processes. Dung being a complete fertilizer in containing all the elements requisite for the growth of agricultural plants, can only be compared in its effects with applications of similar qualities, applied so as to feed the plant in a similar manner. Thus dung can be compared with the Stockbridge manures in field practice, but not with a superphosphate, as the Stockbridge manures contain all the needed elements found in the dung, but in a different proportion, while the superphosphate contains but one of these substances—the phosphoric acid. Hence the uncertainty of a superphosphate, when applied by itself on land out of condition; the certainty of manure; the certainty of Stockbridge manures.

Eighth.—That insurance is as valuable to the farmer as to the business man, as diminishing the risks of the business. Dung has a value from its reliability, in addition to its plant-food value, as under average circumstances it always produces a crop when properly used. A complete fertilizer possesses this insurance quality with dung; a single fertilizing substance does not possess it. Hence the fact that a complete chemical fertilizer can take the place of dung in farm practice, and assume similar reliability as a crop producer. The single fertilizer can be profitably used on the average but to supplement the dung supply, or to supplement a known deficiency in the natural fertility of the land, and for this purpose it assumes a greater or less degree of reliability, and for none other.

Ninth.—That time is an important element in all farm operations, and that it is only through the continuous use of fertilizing substances that the plant-food supply obtains *dissemination* throughout the whole soil, so as to be in the most favorable position for the greatest appropriation by the roots. Hence the value of tillage operations, which tend to commingle the soil particles and thus transfer, in a measure, the position of the fertile portions of the soil, and which become more efficacious for good as the land comes nearer to saturation, or to its capacity for retention of the chemical substances. Hence the danger of judging the efficacy of applications from a single year's results; hence the importance of forms of application which shall admit of the release of plant-food from its combinations continuously during the period of growth.

All science teaches that the valuable portion of all fertilizers consists in the portion of plant-food they contain; that there is no difference between plant-foods of the same kind, quality and quantity, whether supplied by dung or artificial fertilizers; that a complete manure—a fertilizer containing all the elements of plant-food—can take the place of dung in agriculture; that, hence, the amount of farm profits may depend on the relations of price between fertilizers bought and crops sold; that the arable land of the farm may be kept in high condition to the extent of the farm capital, through the purchase of fertility from off the farm; that educated knowledge may oftentimes enable the farmer to extend the resources of the farm manurial substances, through the action of special fertilizers containing single properties of fertility, as potash salts, superphosphate, plaster, etc., but will never enable these substances to profitably replace the proper use of manurial substances containing complete plant-food properly compounded; that plant feeding depends on the plant as well as the soil, and the acts of man likewise influence to disturb existing relations, etc.

To our view Southern agriculture offers more of present promise to modern agriculture than does the Western, while the Eastern and older States offer the most advantages. In view of the price and supplies of plant-food as marketable products, the present character of unmanured soil has but little influence on the results of farming, which depend more on the price of product and the educated skill of the farmer. The Massachusetts farmer *can* buy his plant-food and manufacture into crop on his shallow and naturally deficient soil, and sell his crop, and make a larger net profit than can the Illinois farmer who manufactures like crops from plant-food costing him nothing directly. As large crops *can* be obtained through skill in Massachusetts as in Illinois. The Massachusetts farmer has the advantage of the transportation tax in his farm, the tax always added to production by distance from market, and the advantage of local markets which supply consumers with most varied products. The South has cotton and tobacco for leading crops, and possibilities in the form of other textiles, and crops of special import, as sugar, arrowroot, drugs, etc., yet in places a poor soil, elsewhere the richest of soil; and under these circumstances it seems as if an educated agriculture would be of immense avail—that education which allows of the Southern farmer to cultivate quality as well as quantity for large variety of export crops, and to do this properly, understandingly and profitably from resources within his reach. Western agriculture, on account of the enormous capacity of the country, the sparseness of consuming population, and distance from market, admits of less use of artificial plant-food, and compels the dependence on the accumulated fertility of their fields, and the price of products thus admits of but little recourse to the system of plant-feeding.

In brief, plant feeding is at the foundation and apex of the most successful farming, and manure to the consumer with such a resource offsets advantages of rich lands, and renders possible the application of capital and skill with the certainty of adequate returns. The character of the plant has much to do with the profit of plant feeding and cannot be ignored, and the intelligence of the farmer has free scope for exercise in governing the various relations between the soil, the crop and the fertilizer, in the direction of profit; the price which the crop will bring has a strong influence in stimulating effort and the application of intelligence, and the greater the reward thus offered to intelligence, the greater the use of artificial fertilizers, and the greater advantages which shall accrue from their use.

FORESTRY—FRENCH EXPERIMENTS.

THE following account of a visit to the estate of M. le Comte des Cars, where some most interesting experiments in the cultivation of forest trees have been made, is from the *Agricultural Gazette:*

On June 24, a most delightful day, following one of storm and floods of rain which had revived drooping nature and given freshness and vigor to the whole of the abundant vegetation in the departments of l'Oise and l'Aisne, seven enthusiastic amateurs of sylviculture, including M. le Comte, who, indeed, is a master of the varied and difficult art of forestry, started for Roset-Saint-Albin. In one hour and twenty minutes after leaving Paris the express train took us to Villers Cotterets. There M. le Comte told us frankly that he looked upon us as his prisoners, and that we belonged to him exclusively until 8 o'clock in the evening. There was of course no opposition to this arrangement. From the station, the distance by road to Roset-Saint-Albin is fifteen kilometers, through a charming country, shaded by thick forests, with long vistas of light opening here and there, watered by numerous running streams, and with a sky as blue as are the waters of the great lake.

Every cultivator of forest trees knows that M. le Comte des Cars is the author of a pamphlet on "The Rational Method of Pruning Forest Trees." This method is clearly and fully explained in this treatise, which is further enriched by many excellent engravings. The work has already reached its seventh or eighth edition. It was, in fact, the extended application of this method that we were going to see and study upon the very spot where it had been carried out in its entirety.

As nearer and nearer the end of the journey was approached, M. le Comte interrupted his clever and amusing remarks by saying:

"But we have come to study pruning. Observe those trees at the side of the road, long branches at the base, dead at the summit; and see, these have nothing but the top remaining, an insufficient protection for the poor trunk, which becomes the sport of every wind that blows, stunted and distorted out of all shape and proportion."

In a few words he described his treatment. We followed carefully the trees pointed out by our professor, and can prove with him how very little the trees upon our route offered a resource for future wants.

France, in spite of the ill-considered clearings, is still one of the first countries in the world for its growth of forest trees. This is owing in part to the mountainous regions, unfit for any other description of cultivation; in part to the vast extent of sandy, gravelly soil; and in part, in the rich countries of extended plains, to the traditional and excellent plan of bordering by extensive planting of elms, Canadian poplars, and Lombardy poplars all the fields and meadows.

In Flanders, in Artois, even in Picardy the villages from a short distance resemble dense forests. In spite, however, of her sylvan riches, France has to pay tribute to other nations for more than half the quantity of wood she annually consumes. At home wood to the value of 200,000,000 francs is cut down every year. M. des Cars, and many other eminent men as well as he, believe that in a given time the quantity of home-grown timber might be considerably increased. His method would go far toward insuring so desirable a result.

Arrived at Macreux, we skirted the demesne of the Marquis of Lubersac. M. des Cars here made us observe a change in the character of the trees which bordered the road. They were like those we had already seen—Canadian poplars; of the same age, and raised no doubt in the same nursery, but what a different result! These were vigorous and straight of growth, as large again in circumference, a third higher, and the foliage of an intense green, thick, tufted, and growing in an oval form. The explanation of this phenomenon was given us in two words—the superintendent charged with the care of these trees had followed the same course as that adopted at Pringy and Roset-Saint-Albin; he had, in fact, pruned them in exactly a similar manner, and had profited by it.

We are approaching Pringy, the first of the two properties that we were to visit; a row of trees on either side marked the course of the avenue which led to the mansion; on the left, a stony incline was covered with a close growth of different descriptions of trees; on the right the valley opened, showing a broad landscape, in the midst of which flowed the river Ourcq, which has its source a little higher up, but which already has a current sufficiently strong to make us fearful of its play. On either side of the river, on a damp, turfy soil, there are growing great quantities of Canadian poplars and Lombardy poplars. All these trees have not a happy youth nor a prosperous old age; there are some among them that have lost their leader; a new one is being made by an aerial guardian.

A leading branch is taken, which is raised little by little until it is vertical, and to keep it so it is attached strongly to the upper part of the trunk. In three or four years the tree has remade its leader or leading shoot; in ten years it is again straight; there is no longer any trace of its youthful escapades. M. des Cars can say, like Ambroise Paré, "I dress its wounds; nature has cured it."

We saw a number of elms which had twice been stigmatized as "deformed," and which had now become as straight as the obelisk of Luxor. To straighten the crooked, lift the bent, give movement to the paralyzed, life to the dying, is the aim of that method of manipulation which may be called sylvan surgery. But the benefits are not limited to the infirm; the treatment is applied to those doing well, and increases the value of those which have done well. It may be described as follows: "To arrest the growth of secondary branches and increase that of twigs, in order to increase the number of leaves."

Who, indeed, does not know that the large lower branches live at the expense of the trunk, and that the leaves are the lungs, the breathing apparatus of trees and plants? It becomes necessary, then, to cut for a certain distance from the trunk all the thick branches which have a tendency to grow in a vertical line. This done, these limbs will not grow any larger; the trunk will benefit by all the sap saved. The branches which grow too low down will be cut off entirely. The cut must be smooth and straight, and the wound should be covered with coal tar. In a few years the descending sap will have formed a woody layer over it. It is from the top pruning must commence, so that the operator in descending may carefully observe that no branch extends beyond nor shades another.

When the work is finished the tree should be of the form of an elongated egg. Three years afterward it should be again examined, and from that time it will increase in bulk and in height and present to view that oval and leafy head which M. le Comte des Cars considers is the ideal type of the species. We were shown two large poplars which had undergone this treatment four or five years ago. They were no longer young trees, but each was more than twenty-five years old, which, for trees of this description, may be looked upon as verging toward full age. Before being pruned they were large and top-heavy in form, and cast an extended shade, which was injurious to the growth of vegetation around. They might have been felled, but it was preferable that they should be larger, and in 10 years have an added value of 100 francs.

Some of M. des Cars' woodmen mounted these giants, and in less than a day they cut out of them wood to the value of 55 francs. The labor had cost 5 francs. At the present time these trees are young again. They have completely changed their form. Around their roots healthy vegetation increases, and their value is enhanced at least one-third. The cultivation of timber, thoroughly understood, may be made highly lucrative.

M. des Cars follows it with higher motives. He has instituted at his estate at Pringy a school for pruners. Every year during the month of March this old castle, which has quite a character of its own, is opened for the reception of students, not only from all parts of the country round, but from remote places. Foresters and woodmen come here to go through a course of instruction in their profession, and to learn the practical part of their art. They are made to work, and while working are taught the reason of their labor. The instructors are those men whom M. des Cars himself has taught. The course of instruction lasts ten days, and the pupils only have to pay for board, lodging, and instruction 25 francs each. M. des Cars does not say how much it costs him. At work in the forests of Pringy and of Roset-Saint-Albin they learn those lessons which they will afterward teach in other places. The men climb the trees without spurs, by means of light ladders. As soon as the lower branches are reached they then climb upward to the top, throwing down the dead wood as they go; then they begin to descend, going carefully round each thick limb, and cutting them off short where found necessary. The men use hatchets and other instruments invented by the Comte des Cars. We saw a large oak tree, with a head in the form of an enormous apple, thus manipulated by two men, and in less than two hours the apple tree, so to speak, had again become an oak.—T. S. J.

RAIN WATER CISTERNS.

PURE, wholesome water is a natural beverage for man and animals, and is essential to health. The question often recurs how one can secure a supply of pure water, or how best save and preserve rain water, as it is very difficult to provide a supply from other sources in many localities. Rain water is generally the purest form in which we can obtain water, but it often becomes contaminated with impurities when collected from the roofs of buildings, and needs filtering before using for domestic purposes. Well, river, lake, or pond water is very apt to be impregnated with organic matter, deleterious to health, therefore it would seem most economical, where wells are least practicable, from difficulty of construction or impurity of water when obtained, to construct cisterns for retaining the water which may fall upon the roofs. By this means a constant supply of good water may be had at all times (provided the cisterns are properly constructed) at a comparatively small cost, and will be found one of the best investments in farm improvements.

The most convenient and durable mode of constructing a cistern is to make it of circular form, under ground, with the sides and bottom lined with stone or brick, and arched over the top except a man-hole for convenience of cleaning, and all carefully plastered with cement. Where the ground is sufficiently firm the cement may be plastered directly on the earth, below the reach of frost, but the arch will necessarily have to be of stone or brick. All such cisterns should be covered with earth at least three feet deep, to prevent freezing, and for keeping the water fresh and good. It is always advisable to have two compartments in the cistern—one for the water to enter and the other for drawing from. The division may be of soft brick, through which the water will filter. The cement to be employed in construction should be of first quality, properly worked, and applied with the utmost nicety, to prevent leaks.

The question may arise, How large a cistern will be needed to secure an ample supply? This question is an important one, and cannot be answered definitely without knowing the amount of annual rainfall and the area of roofing from which the water is to be collected. I suppose that it is safe to take as a main average for the different sections of the Northern and Western States, a rainfall of three feet in depth. Allowing such to be the fact, we next must ascertain how many square feet of roofing we have. Each square foot receives three cubic feet of water. To find the number of gallons of water in three cubic feet, reduce the three feet to inches by multiplying by 1,728, and divide by 231, the number of inches in a wine gallon. Multiply the square feet of area covered by roofing by this number of gallons, and you have the number of gallons of rainfall received by the roofing. As all the water does not fall at once, but is distributed in showers through the year, it is not necessary to make cisterns of sufficient capacity to hold the whole at one time, but such proportion as may fall at any particular time or season, allowing for reduction by usage.

Having these points to start on, you may now determine the size of the cistern, to do which the following table will be found of assistance—the right hand figures denote the contents of one foot in depth; left hand figures, size of cistern in feet:

Circular Cistern—Diameter.		Square Cistern—Size.	
5 feet.	4·66 bbls.	5x5 feet	5·92 bbls.
6 "	6·71 "	6x6 "	8·54 "
7 "	9·13 "	7x7 "	11·63 "
8 "	11·63 "	8x8 "	15·19 "
9 "	15·10 "	9x9 "	19·39 "
10 "	18·65 "	10x10 "	23·74 "

W. H. WHITE, in *Country Gentleman.*

THE Holly system of heating houses with steam sent through street mains has just been established in Springfield, Mass., where a gas company has bought the right. Springfield is the second city to try it, Lockport, N. Y., having been the first.

SMALL GREEN HOUSES.

DURING this and previous winters, several small green houses excited my interest, and I have made a "note on it," which is here given for the benefit of those who feel a similar interest with myself.

They are all heated with anthracite coal, by stoves. The smallest is eighteen feet long and nine feet wide. The highest part at the back of the lean-to is seven feet seven inches; from the ground to the roof, in front is three feet. The floor is dug down two and a half feet. An excavation deeper than the floor is made for the stove, which is set near the front, but not quite in the center of the line east and west. A glazed terra-cotta pipe runs from a short galvanized pipe attached to the stove, about three-fourths of the length of the building, under a wide shelf at the front, then crosses the eastern end of the house (the house faces south), and runs up the northeast corner nearly to the roof, and then passes outside, where it rises three or four feet. The top is closed, but several apertures beneath allow the egress of the smoke. There are four elbows to the pipe, the last one resting on a wooden bracket outside of the house, where it is held securely by strong wires. A wide table runs along the front of this house. A narrow pathway intervenes between this and the stage of four steps which fills all the rest of the house, except the pathway between the two stages which runs from the main path to the door; that opens three-fourths of the way from the east end, and is placed in the north wall. From the door we step into a narrow passage-way, or shed, lighted by a window in the east end, and leave it by a door in the west end. This passage protects the house at the north, and prevents a draught of cold air when the door is opened. Three flat wooden shutters on top allow of ventilation. The glass in front is also set on hinges, and permits of more or less ventilation.

When the sun becomes too powerful, panes made of lath are laid over the roof, and are left there all summer to protect it from hail. They make a subdued light and prevent the trouble of whitewashing the glass.

The whole cost of this house was almost exactly $100; the lath-work for the roof costing an extra $4.50. It has been used nearly two winters. The owners have had no trouble this winter with gas, since substituting the terra-cotta pipe for an ordinary sheet iron one, which in the previous winter rusted into holes and allowed the gas to escape, and do some slight damage. This house is exposed to all the north blasts; but so far no flowers have been lost by cold. The stove is attended once in twenty-four hours, and consumes about one ton of coal in a season. It is a self-feeder, but is never filled up high enough to require the feeder.

Another house about eleven feet wide and sixteen feet long (we could not get the exact dimensions), faces the east, and is built up against a high back building facing west. The stove stands in the middle of a square left in the center. The pipe to this is galvanized, and goes up straight through the roof, where it is held in position by wires fastened to the wall. During high winds gas has sometimes been thrown back into this green house; but no serious disaster occurred till this winter, when a varnish which had been applied to the outside of the pipe had, unknown to the owners, found entrance, and with stringy festoons had formed a barricade, which on one dark night sent out such a volume of gas as nearly stripped every leaf from every plant in the house. Some few plants were entirely killed. The only ones escaping injury were Amaryllis and Peristrophe angustifolia, which with its gay yellow and green leaves, and bright rosy-purple flowers, seemed almost too jubilant amidst the general desolation. We had seen the whole place a short time before in a blaze of beauty. The contrast was somber. The stately Callas in bud and flower, and shorn of their leaves, looked like dignified poverty. This house has a high shelf at the back, running the full length of the house, and near enough to the roof to allow only plants of moderate height to be accommodated. This shelf held some earth or tan, on which the pots were set. Kenilworth ivy and Tradescantia zebrina were planted along the edge and fell in lovely green drapery nearly to a second shelf below, where ferns and other shade loving plants were kept. The under shelf extended front as far as the door, which was in the north end, and across the south end, meeting a shelf which extended the whole length of the front, and around again to the door. Hanging baskets were suspended to the roof, and wall-pots to the north wall. The peristrophe filled one of these and trailed down the side, making gayety amid the gloom, and assisted somewhat by a stately Cyclamen in another wall pot, the flowers of which remained uninjured, while a few leaves had been burned up completely. The floor of this house was perhaps eight or ten inches below the surface of the yard.

Another house, of much less pretensions, was made of rough boards up to the height of the window, which were of old window frames fastened together, as was the roof and east end, the house facing south. The west end was partly formed by a fence and partly by rough boards. The back was a storehouse, which protected it entirely from the north. This house is heated by a self-feeding stove that stands near the door, which is in the southwest corner. The pipe runs up through the roof. Two wide shelves extend along the back of the house, one above the other, the upper being the narrowest. The lower shelf extends along the east end. A small shelf is placed high up at the west end. This is rather a cool house; the Begonias, and other heat loving plants, declined to flourish there till made quite warm. The plants that could bear a coolish atmosphere flourished and bloomed in exquisite beauty. The Zonale Geraniums Dr. Koch and Jean Sisley took on an extra garb of loveliness and even of size in the flower; while Oxalis versicolor became so dainty and fairylike a beauty as to pass beyond the knowledge of its former owner, who had never known its perfections or its capabilities. This house required very little fuel. One night, however, it was forgotten altogether, and Jack Frost swooped down with a keen blade and smote so fiercely that the delicate plants never again lifted their heads. Great lamentation ensued, among owner and friends; but it would not restore the lost beauty, nor even build the fire.

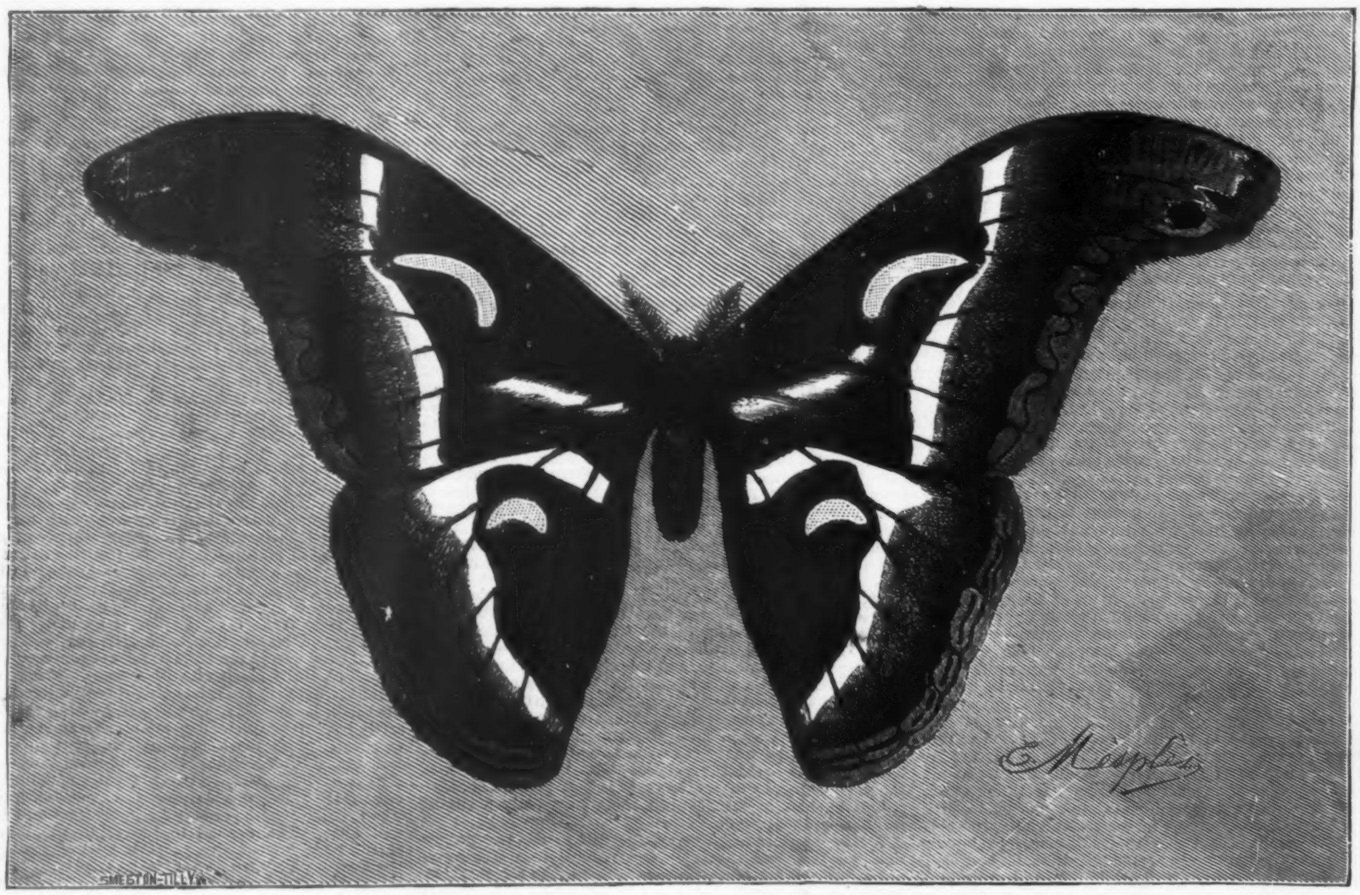
I heard a florist say it did not pay him to cultivate his flowers all the year, and then by a night's neglect lose all he had gained; so when severe weather approached he sat up at night and mended his fires, and so saved when others lost. "Well lived, well saved," says the proverb.—*Gardener's Monthly.*

THE VACUNA MOTH.

COMPARATIVELY speaking, the fauna and flora of the heart of Africa are unknown. Owing to the difficulties attending the transportation of specimens few expeditions have done more than to solve great geographical problems. Among the few explorers who have done considerable toward increasing our knowledge of the fauna of the vast and unknown regions embraced in their field of operations, may be mentioned the name of M. Marche, the companion of M. di Bagga and the Marquis de Compiègne in their different expeditions in search of the head waters of the river Ogowai. The innumerable dangers and continual obstacles to which he was exposed did not permit this gentleman to make collections embracing specimens of the entire animal kingdom, but the insects that he collected have given us an excellent idea of the fauna of the territory through which the Ogowai flows.

In the equatorial regions of Africa insects, with the exception of mosquitoes and termites, are said to be comparatively rare; butterflies show themselves occasionally, and, at certain moments the traveler finds himself in the midst of a regular snow storm of living flakes, due to the presence in immense numbers of small white winged lepidoptera of exceeding delicacy. These little butterflies belong to the large family of *Perides*, and to the genus *Terias*, distributed through the two hemispheres. An enumeration of the numerous species of lepidoptera collected by M. Marche would be out of place here; it is enough to say that he has greatly enriched the collections of several museums. One of the specimens, however, is so worthy of note that a representation of it is given herewith. It is a large moth belonging to the family of *Bombycidæ*, in which are included various native and exotic silk-worm moths. This moth is remarkable for the size and markings of its wings, which ally it with certain American and Asiatic forms of the same family. Near the middle of each of the wings there is a large kidney-shaped yellowish spot having a white center and a narrow black edging; the fore and hind wings are crossed by a wavy white band, and the fore wings are also marked with a white band starting from their base and extending to the center of the wing; near the tips of the fore wings there is an eye-like black spot bordered by a narrow white crescent. The only known specimens of this beautiful insect were brought from the country of the Ashantees, and are now in the collection of the British Museum. Mr. Westwood has named this moth (the male of which is shown in our illustration) *Saturnia vacuna*, although it is apparently very closely allied to our common large American cecropia moth, and probably belongs properly to the same genus—*Platysamia*.

M. Marche captured his specimens of this species near the village of Ngeime, on the river Ogowai. As a contribution to what we already know of insects used as articles of food, this gentleman states that the native children hunted these moths with the greatest zeal; and, having captured them, sucked out the contents of their fat abdomens with as much gusto as if they had been the most delicious fruits.



THE VACUNA MOTH. (MALE.—NATURAL SIZE.)

HOW INDIANS CATCH WHITE FISH.

MR. W. B. DEVEREUX, writing from Sault Ste. Marie, Mich., describes as follows the peculiar style of fishing practiced by the Indians at that point: "Seating myself in a canoe, one Indian took his position seated in the stern, and another stood in the bow. The one in the stern used a paddle to keep the boat's head up stream, while the other used a pole to steady the boat. We had a dip net about four feet in diameter, with a handle twelve or fifteen feet long. This was hung over the projection of the cut-water, while the handle trailed back in the water. Thus equipped, we sallied out into the rapids, which are half a mile in length and one mile wide. At the foot of the rapids the fishing is done. The water boils and tumbles, like the swiftest rift on the Delaware, and is generally half white with breaking foam. With his pole, the Indian in the bow holds the canoe or lets it float steadily sidewise, now up a little and then down, but always under perfect control and always dancing with the rush of water. He watches the water constantly, which varies in depth from two to nine feet. Suddenly with a quick motion he shoves the end of the pole under the bow piece, grasping the net at the same time with the other hand, and, never taking his eye from the water, plunges it in, perhaps ten feet away, and forces it to the bottom, or as the canoe sags back with the current lets it drop a few feet, and then with a peculiar twist raises it to the surface, and with a toss like turning a flap-jack, drops a five-pound white fish into the canoe. This was repeated time and again, right in the swiftest water, and seldom only one fish was caught, but once six that would weigh eighteen pounds. Often I could not see bottom, and one was caught in eight or ten feet of water. I could see no fish until they were brought to the surface. It was the only kind of fishing that I ever saw that I did not think I could learn to do."

of a
e in
ex-
arge
ugh
rous
out
en-
pec-
n of
the
tive
for
tain
the
ped
lack
avy
hite
r of
like
only
rom
tion
this
ion)
sely
oth,
us—

the
tion
ood,
hese
em,
uch

arie,
prac-
in a
and
pad-
used
feet
This
the
llied
one
lone.
the
oam.
lets
, but
the
h va-
quick
iece,
and,
haps
anoe
then
toss
into
n the
, but
could
et of
o the
saw